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TECHNOLOGY DEPARTMENT

FUEL — ELECTRICITY — MACHINERY — METHODS

EMPIRE BUILDING, PITTSBURGH, PA.

To Educate the Engineer in Industry

OCTOBER 1924

Containing the Proceedings of the A.I.&S.E.E.

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DETROIT.

Iron and Steel Exposition

Electrification of Tata Iron Works at Jamshedpur, India

By S. GHOSH
Electrical Engineer, Tata Iron & Steel Company
Jamshedpur, India

Pulverized Coal Used as Fuel in Sheet Mills

By JOHN GLEW
Electrical Engineer, Ashtabula Steel Sheet Company
Ashtabula, Ohio

Discussion on Electrically Driven Reversing Mills

Discussion on Slagging Producer in Steel Works

Power Factor Correction

By R. A. NEAL
Manager Switch Section Supply Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Discussion on Fuel Savings Conference

By W. C. BUEHL, JR.
Engineer, Chapman-Stein Furnace Company
Mt. Vernon, Ohio

The Ten Commandments of Salesmanship

By DR. FRANK CRANE

LAMINATED commutating poles are an exclusive feature of Westinghouse Mill Type Motors. This exclusive Westinghouse characteristic is the finest guarantee of good operation during plugging or reversing duty and heavy peak loads. Good commutation is assured; the life of both commutator and brushes—and consequently the life of the motor itself—is lengthened.

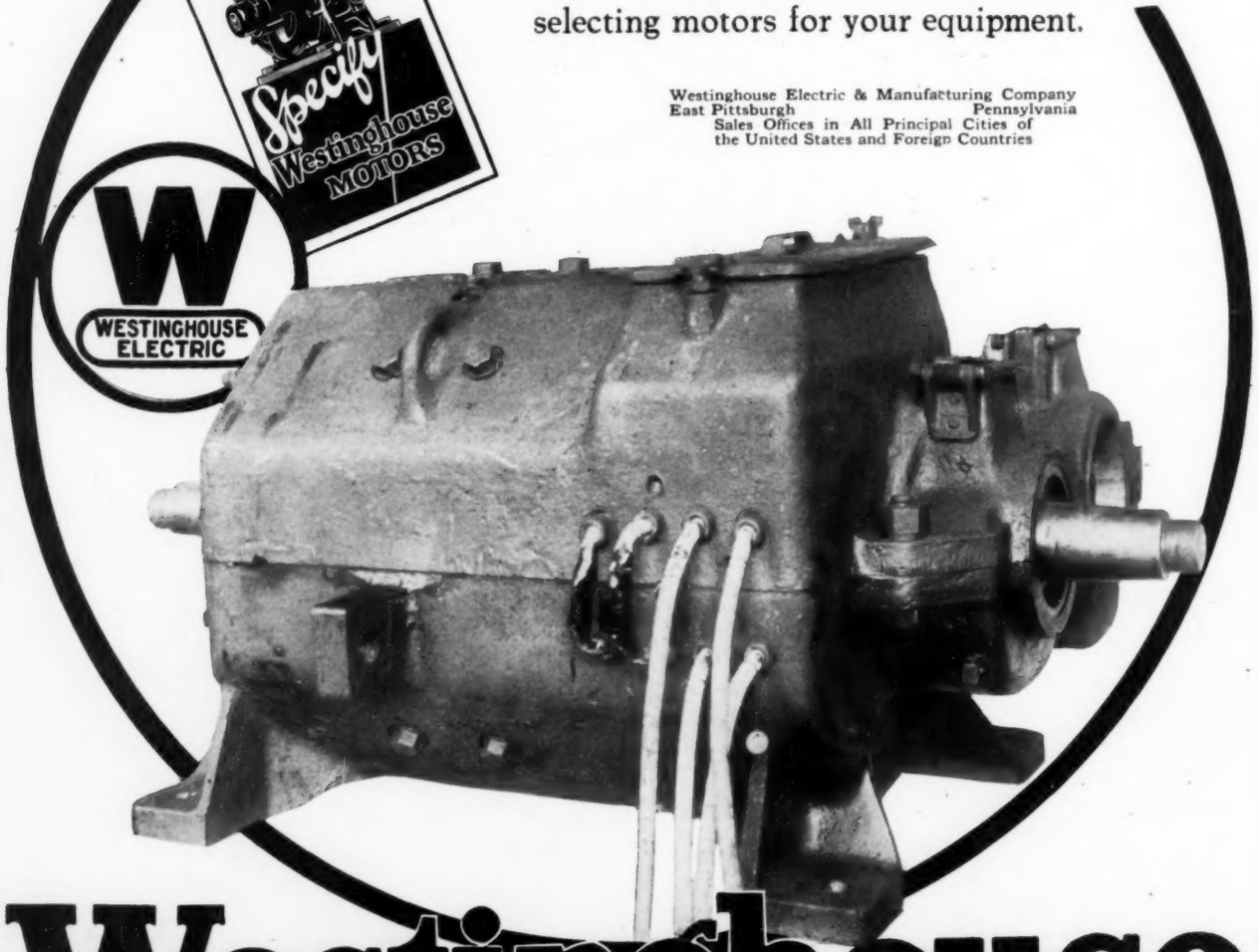
Its extensive use emphasizes the fact that the Westinghouse Mill Type Motor stands alone in exceptional performance.

Let Westinghouse Electric engineers assist in selecting motors for your equipment.

Important Characteristics of Westinghouse Mill Type Motors

Fireproof windings.
Long life of commutator and brushes because of low brush current density and deep commutator segments.
Sparkless commutation under severe operating conditions.
Long bearing life because of low bearing pressure and large dust-proof bearings.
Quick reversal resulting from small fly-wheel effect of the small diameter rotor.
Easy to repair because of simple construction.
Built to withstand the most severe mill service.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania
Sales Offices in All Principal Cities of
the United States and Foreign Countries



Westinghouse

IRON AND STEEL ENGINEER

J. F. KELLY, Editor

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Subscription Price $5.00 per Year. Single Copy 50c.

Newly Elected President of A. I. & S. E. E.

ALDEN C. CUMMINS was born in the City of Pittsburgh on July 18, 1887. His primary education was secured in the Pittsburgh Public Schools, and upon completion of his studies there he entered Shadyside Academy, Pittsburgh, graduating with the class of 1905. He entered Lehigh University, securing his degree in Electric Engineering in 1909. He then took up post graduate work in Mathematics and Mechanical Engineering.

ALDEN C. CUMMINS
President-elect, Association of Iron and Steel Electrical Engineers, for the year 1925

His first technical position was with the South Penn Oil Company at Folsom, W. Va., where he assisted in the development of the first successful application of electricity in the oil fields. He then entered the employment of the Westinghouse Electric & Manufacturing Company as a cadet engineer in their Engineering Department.

In 1911 he started his steel mill work with the Carnegie Steel Company at their Duquesne Works, acting in the capacity of Assistant Electrical Engineer, which position he held until 1912. He then was promoted to Assistant Superintendent of the Electrical Department and acted in that capacity for six years or until 1918, when he became Superintendent of the Electrode and Ferro Alloy Departments, which position he held for about two years or until 1920. During this period he developed, constructed and operated the only Ferro Alloy and Electrode Departments ever constructed in the steel industry.

In 1920 he became the Superintendent of the Electrical Department, in charge of all electrical engineering and operation, and has occupied that position to this time.

Mr. Cummins has been active in various engineering societies, and aside from taking part in numerous discussions he has presented a number of papers, a few of the later ones being, "The Elements of Electrical Maintenance in Industrial Plants," presented in March, 1922, before the Pittsburgh Section of the A. I. E. E.; "Factors Affecting the Solution of the Electric Blast Furnace Hoist Problems," presented before the 1923 National Convention of the A. I. & S. E. E.; "Developments in Electric Repair Shop Practice," presented before the National Convention of the A. I. & S. E. E. in September, 1924.

Aside from being an active member of the A. I. & S. E. E., he is a member of A. I. E. E., The American Electro-Chemical Society, and Western Pennsylvania Engineers' Society.

Mr. Cummins has been a Director of the Pittsburgh Section of A. I. E. E. He has held various positions with the Association of Iron and Steel Electrical Engineers, first as Chairman of the Educational Committee, then Chairman of Pittsburgh Section; later a Director, then Vice President, and at present he is President-elect, and on January 1, 1925, will assume the duties of President.

EDITORIALS

REPORT OF THE SECRETARY

By F. W. CRAMER*

DURING the past year, our association has put into practice a new policy that involved some changes in the governing organization. Owing to the growth both in the amount of business handled, and in the membership, it was deemed advisable to create the office of business manager, such position to be filled by an election by the board of directors. The holder of this office is to be directly responsible to the board, but not a member of it. This re-organization changed the status of the office of secretary, and made necessary the election to that office of one of the directors, and this in turn made room for an additional member on the board. The office of secretary having thus been created and filled, some report of the activities during the past year is in order at this time.

Before doing that, it might be well to record that we have been under the guidance of capable men during the past 12 months. We have been fortunate in having another faithful hard working president, Mr. R. S. Shoemaker, who devoted many days of his time fulfilling the duties of the office, and expanding the policies and prestige of the association. His assistants, the first and second vice presidents, have also given unsparingly of their time so that we have been truly fortunate in the selection of our leaders. The other members of the board have given these men their unqualified support, so that our progress during the past year was a natural one. Working hand in hand with these men, with a devotion and super-enthusiasm that could not be downed, was our business manager, whose ideas and hard work have enabled us to occupy the place we do among engineering societies.

I believe it is the wish of the board that I mention one of our pioneer members at this time, and I do so with both regret and good wishes; regret because he has passed from our active membership list, and good wishes because he has risen to something bigger and better. None of us can realize the actual number of hours, days, and weeks during his 15 years of active membership that he freely devoted to association work, and time alone can give a fair value of its worth. We lost one of our most valued members when Mr. E. Friedlander left the steel industry and active membership, but we can rest assured that his friendship for the association will always exist.

To give a detailed report of the happenings at the board meetings would be an uninteresting chronicle of the minutes of the various sessions, and rather than burden you with many uninteresting things, this report will be confined to three subjects with hopes that you may be impressed by a few of our most important problems.

The first of these is membership dues, which constitute one of the regular puzzles at the board meetings; why is it that we always have so much money on our books as delinquent dues, and most of this for more than two years back? Neglect and thoughtlessness are the main reasons for we have found that in most of the cases investigated that the delinquent could put his dues on his expense account, but had not taken the trouble to write a check.

In addition to the privileges he enjoys, every member is getting more than $10.00 worth of literature each year, which he gladly accepts yet forgets to pay his dues in return. We have tried all manner of kind-hearted ways of bringing in this money without results. We have never cared to go to the extreme method of turning these accounts over to a collector to be secured by means of arrest under the postal laws that make you liable for payment by accepting the publications—but due to this kindness, the delinquent account grows larger each year.

The association is not on the verge of bankruptcy, but enjoys a sound financial standing. Further, we are standing more and more on our own feet each year. Just last January, it was decided to cease taking gifts from steel companies as sustaining memberships, and also from manufacturers in the form of advertisements for our yearly proceedings These are steps forward and away from charity, but in order to keep advancing our financial standing, and to keep growing stronger each year, a way will have to be devised to reduce our charity membership list.

For a second thought, I wish to bring to your attention the wonderful progress made by our Combustion Section during the past year. The papers and discussions brought out have been a pleasant surprise to even the most ardent follower, and a credit to our organization. This branch has grown to such importance that a two day convention on combustion subjects was held in Pittsburgh last April. The June issue of the magazine is a proof of the magnitude of these meetings, and of the value to the steel industry. We have hopes that this section will soon occupy the place in the combustion division of the steel industry that the parent organization holds in the electrical division.

The third and last thought deals with our greatest achievement during the year, and one that we should all point to with pride—the present monthly publication. It had been realized for some time that the former size was not suitable for pictures and cuts, and required a special size of plates for advertisements. These things, from a business point of view, were considerable of a handicap, but on the other hand changing over to the present size meant a lot of expense, a bigger publication, and a greater undertaking, but the step was taken, and has proved one of the best things we ever did, as both the articles and advertisements more than justify the change. We feel that we are now publishing a real magazine that will stand comparison with any technical publication on the market—yet it serves a field of its own. Many of these papers would never be written for a commer-

*Secretary A. I. & S. E. E. Assistant Electrical Superintendent, Bethlehem Steel Company, Johnstown, Pa.

cial publication, and no attempt is made to commercialize on the articles in the advertisements. Each month it grows better in contents, and greater in circulation, and the most amazing part is that the editorial and business staff consist of two men and a stenographer who not only do this work but all the other work of the national organization. Our members have so far contributed the material for the editorials, but these contributors represent but a small percentage of the membership. It is hardly fair for this minority to be giving the good things from their operating experience and mill problems to the great majority, and getting only glory in return. We are looking forward to a time when a majority will contribute something during the year, and thus make it the most valued publication, for steeel men, in the market. If you are afraid to undertake writing an article yourself, the Business Manager is always willing to write the story if you will only furnish the idea, a picture, or a sketch.

In the final analysis of things, it is this monthly magazine and the yearly proceedings that really count. They are the assets on which this association must grow or die—stand or fall—for they are the things of lasting value that uphold the purpose of the organization. Outings, Christmas parties, and conventions, it is true, exemplify the good fellowship division of the association, but they are soon over and forgotten, while the magazine and proceedings are recorded for all times. If you have never written a line for these books, or contributed an idea, these permanent records bear witness to the fact, and you have deprived yourself of the opportunity of getting the credit for that which you have contributed toward the successful operation of electrical drives in the steel industry. We hope that more of the members will take this opportunity of getting on these permanent records by contributing a line or two during the coming year.

In closing, I wish again to emphasize these three thoughts:

(1) The Solution of Back Dues.
(2) The Combustion Section.
(3) The Monthly Publication.

REPORT OF THE SPECIAL BEARINGS COMMITTEE

By D. M. PETTY*

THE Bearings Committee of the Association of Iron and Steel Electrical Engineers held a two-day conference together with a committee from the Power Club and a number of ball and roller bearing engineers in January at Cleveland. At this meeting the work which was done at the Buffalo meeting of the association was thoroughly reviewed, and after considerable discussion it was agreed that in general the 300 series bearing should be adopted as the standard series of ball roller bearing for general purpose motors.

At this meeting there was considerable discussion as to the proper size of bearing that should be used in any particular motor, and a list of sizes was drawn up. After this meeting a number of the ball bearing engineers met in a separate meeting and the subject was again reviewed. At the conclusion of this discussion the ball bearing engineers again recommended that the 300 series bearing be used except that in a few cases the 400 series bearing was thought to offer some few advantages. In view of the fact that the ball bearing engineers opened the subject after the January meeting, sponsored by the Power Club, the Power Club at its May meeting did not fully approve any standardization of ball bearings for general purpose motors. However, since the subject has been reviewed on three different occasions and that on each of these occasions the 300 series was considered the best available bearing for general purpose motors, the Bearing Committee of the Association would offer the following recommendations:

"Studies of ball and roller bearing applications made by the manufacturers of such bearings, by manufacturers of motors as well as by the members of this committee have indicated the probability that all requirements for bearings of this type can be met by the use of the 300 series bearings within the limits indicated below.

"The motor manufacturers, however, have not yet had a sufficiently wide experience to warrant their agreeing to definite standardization at this time. It is, however, felt that pending further information, all applications of ball and roller bearings to motors within the limits indicated below should be made from the 300 series.

"It is, therefore, recommended that pending standardization where ball or roller bearings are used on general purpose motors in frame sizes from 1 hp. at 1750 rpm. to 100 hp. at 1150 rpm., bearings shall be used having inside diameters and outside diameters corresponding to the 300 series. This includes medium duty, standard, and extra wide ball bearings, also, roller bearings."

It is felt that the above report should be put before the members of the Association at this time so that in buying new motors equipped with ball or roller bearings or in equipping existing motors with ball or roller bearings, they can be guided by what will apparently be the final answer in the matter of standardization of ball and roller bearings for motors.

In addition to the work of standardization, the bearing committee, last winter arranged for a series of meetings at which the subject of ball and roller bearings was discussed by bearing engineers in the various sections. These discussions all were printed in the May issue of the Iron and Steel Engineer. All engineers who apply ball or roller bearings in the future, should carefully study the discussions in this issue and should keep such records as will assist them in future years in presenting further discussions on this subject, as the final adoption of ball and roller bearings in the industry, as a whole, will depend entirely on the service record rendered by the ball and roller bearings when they are in actual service.

It should be borne in mind that your bearing committee undertook a rather difficult task in attempting to secure a unanimous agreement on the question of bearings from not only the builders of motors, but also from the builders of bearings. Standardization usually occurs after accepted practices have been in use, however, the object of the bearing committee was to make plain the necessity of standardization in the application of ball and roller bearings to the bearing

*Chairman Special Bearings Committee, A. I. & S. E. E. Electrical Superintendent, Lehigh Plant, Bethlehem Steel Company, Bethlehem, Pa.

builders and to the motor builders. Standardization is not of such vital importance to the builder of bearings, but it is of great importance to the users of motors equipped with these bearings. The motor builders would have probably found it easier to apply that particular bearing to each of their motors which lended itself to the design of that particular motor as it now exists with sleeve bearings. Five (5) years hence, however, users of motors would find that they had in use ball and roller bearing motors with a large variety of bearings in their storehouse to properly protect themselves against service interruptions. It is to adjust this condition that the bearing committee of the Association has endeavored to apply an ounce of prevention so that the pound of cure would not have to be applied five years hence.

The bearing committee is not particularly interested in what series or what kind of bearings are put into motors, so long as they are properly applied and meet some standardization program. With these thoughts in mind, the committee would urge that the Association of Iron and Steel Electrical Engineers follow as closely as possible, the tentative standardization as it is now set up, because it will undoubtedly be adopted as standard practice in the very near future.

A. I. & S. E. E. Board of Directors—1924

R. S. Shoemaker, President; A. C. Cummins, First Vice President; G. H. Schaeffer, Second Vice President; James Farrington, Treasurer; R. B. Gerhardt, Past President; W. S. Hall, Past President; S. S. Wales, Director; W. C. Kennedy, Director; H. E. Davis, Director; A. F. Jones, Director; W. M. B. Connally, Director; F. W. Cramer, Secretary; John F. Kelly, Business Manager.

MEETINGS AND PAPERS

Cleveland Section

Executive Committee—A. W. Mohrman, Chairman; R. E. Scovel, Vice Chairman; George R. Roemer, Past Chairman; R. S. Sawdey, Walter H. May, James Caputo, R. H. Bahney, Gordon Gage.

Papers Committee—S. L. Henderson, Chairman.

Meetings Committee—W. W. Adams, Chairman.

Membership and Attendance Committee—Henry Urban, Chairman.

Secretary—A. R. Lintern, 7960 Lorain Avenue, Cleveland, Ohio; Hemlock 2411.

Program of Papers

Monday, November 10—

"The differential Pressure Steam Generating System," by Mr. Lester P. Barlow, Engineer, Brown Hoisting Company, Cleveland, Ohio.

Saturday, December 13—

"Special Features in D.C. Control," by Mr. W. Dean, Chief Engineer, Sundh Electric Company, Newark, N. J.

Monday, January 12—

"Steel Treating and Its Value to the Steel Industry," by Mr. R. F. Crump, Engineer, Stroh Steel-Hardening Process Company, Pittsburgh, Pa.

Saturday, February 14—

Annual Dance and "Get-together" Meeting.

Monday, March 9—

"Methods Employed in the Manufacture of Steel Cables," by Mr. C. C. Sunderland, Chief Engineer, John A. Roebling's Sons Company, Trenton, N. J.

Saturday, April 11—

"Electric Power Generation by Blast Furnace Plant," by Mr. O. C. Callow, Chief Electrician, Trumbull-Cliffs Furnace Company, Warren, Ohio.

Chicago Section

Executive Committee; R. L. McIntosh, Chairman; H. E. Davis, Past Chairman; Gordon Fox, Vice Chairman; F. L. Collins, A. R. Dibbens; W. H. Williams, Secretary.

Papers Committee—F. A. Wiley, Chairman; L. M. Gumm, W. D. Cameron.

Membership Committee—J. J. Booth, Chairman; Carl Els, T. C. Walsh.

Attendance Committee—F. J. Burd, Chairman; R. O. Herbig, Edw. Otto.

Meetings

October 23—Ore Bridge Control.

December 4—Automatic Substations.

January 19—Primary Resistance Starters.

February 26—Combustion night.

April 8—Synchronous Motors on Mill Drive.

May 20—Interesting and Special Applications of Auxiliary Control in Mills.

Pittsburgh Section

Executive Committee—R. E. Lewis, Chairman, Youngstown Sheet & Tube Company, Youngstown, Ohio; H. C. Mosley, Vice Chairman, Wheeling Steel Corporation, Wheeling, W. Va.; J. J. Booth, Past Chairman, Gary Tube Company, Gary, Ind.; V. I. Brinker, American Sheet & Tin Plate Company, Vandergrift, Pa.; F. E. Leahy, National Tube Company, Pittsburgh, Pa.; T. B. Moffatt, Assistant Secretary and Treasurer.

Entertainment Committee—George W. Quentin, Paul Jones, J. H. Overpeck, Don Ballard, J. H. Albrecht, A. Holcomb, J. J. Bangert, Saul Lavine, J. R. Lewis, W. J. Johnson, F. Tremellan.

Papers Committee—C. Proudfoot, Chairman; E. A. Hurme, A. G. Place, E. Harry, M. S. Robinson, J. Morgan, F. Patterson, A. Duncan, Walker Anderson, A. G. Pierce, C. H. Hunt, R. F. Chaffin.

Membership Committee—R. M. Hussey, Chairman; J. J. Hess, M. Cobbledick, R. B. Davenport, J. H. Barker, J. J. Riles, O. R. Jones, A. G. Hopkins, A. B. Churchill, Wm. Jackson, A. R. Leavitt, J. C. Booher, C. E. Bedell, A. R. Jackson, Wm. Flanagan.

Reception Committee—W. C. McKibben, W. L. Fader, F. A. Schuster, J. B. Crane, George Stimple, W. I. Moore, C. A. Swartz, E. S. Stickle, Jos. Jaques, S. Farrell, F. J. Crolius, E. P. VanKirk, J. C. Mundo, George E. Rhoades, P. H. Schaum, W. L. DeCoursey, J. T. Peden, Paul Caldwell, Wm. Wray, J. S. Rowan.

Philadelphia Section

Executive Committee—P. T. Vanderwaart, Chairman; W. H. Burr, Past Chairman; H. S. Boone, Vice Chairman; A. J. Standing, F. O. Schnure; Linn O. Morrow, Secretary, The Schaff Building, Philadelphia, Pa.

Meetings and Papers

Saturday, November 8—

Reading Meeting, Berkshire Hotel, Reading, Pa. "The Measurement of Electricity." "Indicating, In-

(Continued on page 560)

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF LABOR AND INDUSTRY

BUREAU OF WORKMEN'S COMPENSATION

*** Days Lost from Accidents Reported to the Bureau of Workmen's Compensation, January to August Inclusive 1924**

CAUSE	Building and Contracting	Chemicals and Allied Products	Clay, Glass and Stone Products	Clothing Manufacture	Food and Kindred Products	Leather, Rubber and Composition Goods	Liquors and Beverages	Lumber and its Manufacture	Paper and Printing Industries	Textiles	Laundries	Metals and Metal Products	COAL MINES		Transportation and Public Utilities	Quarries and Mines Other Than Coal	Tobacco and its Products	Miscellaneous Industries	Hotels and Restaurants	Mercantile Establishments	Jobbers and Warehouses	Municipalities	Total
													Anthracite	Bituminous									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Machinery,	37,327	18,501	58,911	5,257	22,213	8,944	7,164	78,452	32,528	43,838	6,487	221,479	24,097	53,452	15,107	8,398	1,635	21,642	2,220	16,210	2,013	9,213	785,298
Boilers,	6,113	40	6,064	-------	32	-------	22	6,021	42	20	12	6,713	354	67	6,287	14	-------	62	-------	40	-------	20	31,923
Pumps, Compressors & Prime Movers,	3,206	2,747	31	25	456	628	764	721	314	70	21	9,422	7,348	2,608	7,068	234	-------	514	33	75	-------	806	37,150
Transmission,	160	4,640	19,512	56	12,180	96	-------	6,270	136	163	34	19,480	18,468	417	6,103	6,496	-------	68	-------	39	18	-------	94,336
Elevators,	44,033	250	18,440	556	6,733	6,244	76	298	12,176	260	10	15,828	26,387	397	6,232	121	24	24,003	12,346	30,490	6,596	196	222,298
Cranes & Derricks,	89,021	8,292	7,805	-------	6,568	145	10	329	162	94	-------	195,771	29,402	1,996	44,517	9,954	4	625	-------	294	125	91	396,295
Cars & Engines,	88,361	12,802	24,296	2,483	556	10,634	86	1,779	13,074	4	-------	227,719	496,668	368,189	906,724	17,193	33	6,630*	13	7,816	181	9,043	2,194,373
Motor Vehicles	48,000	1,052	628	152	14,524	247	221	667	6,495	484	139	23,273	6,529	6,610	333,353	6,579	70	20,396	6,191	21,903	1,177	56,265	554,948
Horse Vehicles,	7,638	6,378	329	20	697	7	143	14,246	48	49	56	873	681	7,199	48,300	117	-------	1,803	6,006	7,351	168	13,861	116,021
Hand Trucks,	2,584	797	9,278	194	1,299	579	36	837	1,374	6,746	12	51,669	759	943	13,092	246	52	6,624	693	901	6,402	202	105,379
Water Craft,	12,646	6,039	10	-------	-------	-------	-------	14	-------	-------	-------	6,169	-------	101	6,258	86	-------	6,000	-------	6,027	-------	-------	43,341
Handling Objects,	85,653	6,923	33,538	2,795	16,582	9,200	1,039	10,137	4,344	4,758	262	171,985	73,973	55,749	69,773	10,533	6,603	33,626	4,535	24,321	9,217	22,474	649,520
Hand Tools,	37,458	3,342	4,659	456	5,454	12,115	100	20,028	854	12,910	30	100,153	52,873	33,073	9,642	2,261	94	2,106	902	11,214	429	14,605	327,058
Electricity,	24,494	12,160	7,514	35	109	41	-------	92	6,067	39	6,000	39,308	43,564	43,470	91,566	56	-------	90	7	60	4	6,026	281,192
Explosives & Explosions,	14,397	98,258	6,443	6	7,414	10	22	6,050	80	69	-------	32,252	477,948	350,785	21,288	18,417	-------	3,166	158	12,095	50	364	1,055,278
Hot & Corrosive Substances,	46,406	28,164	7,925	518	7,531	658	128	496	1,046	14,956	145	131,175	40,295	14,381	45,118	6,347	-------	19,490	7,223	12,687	183	31,025	415,827
Falling Objects,	160,134	7,367	16,229	118	1,719	557	101	15,562	1,013	851	24	146,610	47,176	25,931	41,153	7,238	75	7,808	205	8,682	6,052	49,945	544,651
Falling Objects (Mines & Quarries),	102	-------	18,756	-------	-------	-------	-------	-------	-------	-------	-------	93	996,132	900,973	-------	36,212	-------	-------	-------	-------	-------	64	1,952,332
Fall of Persons,	209,783	46,756	34,719	1,901	5,792	7,398	12,826	16,110	15,213	10,961	383	160,015	65,186	46,958	98,733	13,904	6,383	22,644	8,794	27,865	1,962	34,761	909,067
Stepping upon or Striking Against Objects,	3[illegible],509	1,410	2,675	932	8,254	751	259	13,477	7,122	1,544	168	35,388	18,161	5,792	11,140	456	283	2,146	647	15,803	1,115	7,297	170,261
Miscellaneous Causes,	94,254	19,052	7,555	6,439	15,635	378	6,099	3,647	626	6,712	92	80,614	57,712	62,125	26,272	24,871	86	26,453	12,403	8,206	6,614	106,519	574,346
Total,	1,107,279	285,060	265,397	22,028	143,778	59,632	29,087	195,833	92,710	104,546	13,875	1,776,480	2,484,614	1,987,876	1,798,786	169,735	15,342	206,498	62,492	212,139	42,967	364,856	11,450,970

* Weighted according to the scale of time losses for weighing industrial accident disabilities recommended by the International Association of Industrial Accident Boards and Commissions.

Iron and Steel Exposition

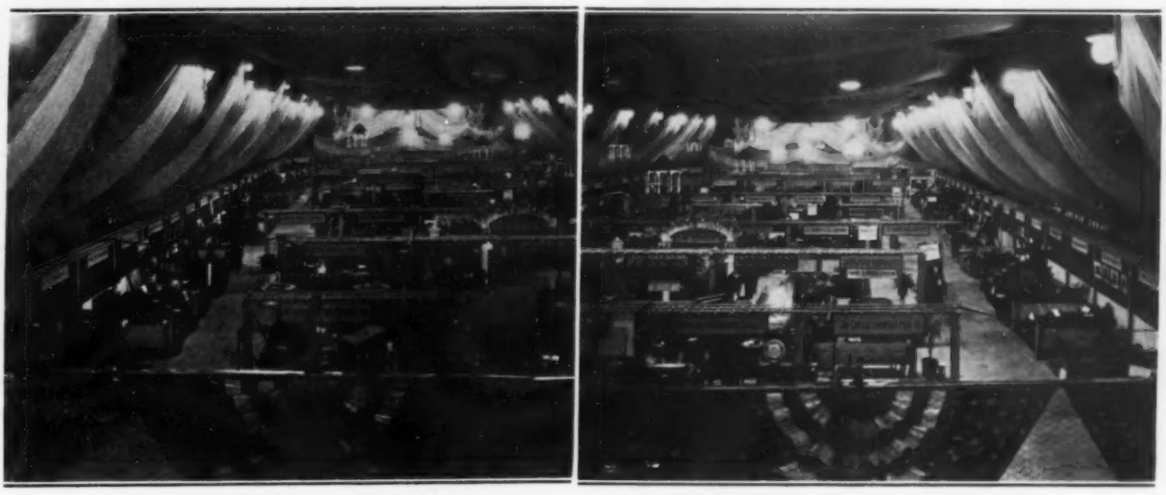
TWENTY-FIVE thousand steel mill men, consisting of presidents, vice presidents, managers, superintendents, combustion, electrical and mechanical engineers, metallurgists, foremen and their assistants visited the convention and Iron and Steel Exposition conducted under the auspices of the Association of Iron and Steel Electrical Engineers in Pittsburgh, week of September 15 to 19, 1924.

On a number of occassions at the exposition, the attendance was so great it was necessary to close the doors, thousands being forced to stand their turns to admittance.

The general public was not admitted. Our attendance was made possible due to the interest created by the membership in general—also due to the active interest taken by the executives of the steel industry in general.

Iron and Steel Exposition.

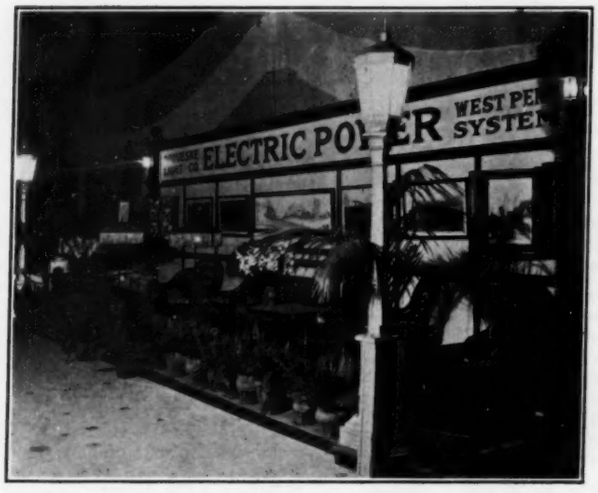
One hundred and fifteen representative manufacturers exhibited the latest and most modern developments in the electrical, mechanical and combustion arts. The interest shown by both the exhibitors and the visitors was remarkable. Many manufacturers expressing themselves as being highly pleased with the reception accorded them by the steel mill executives and their assistants.



General view of Iron and Steel Exposition.

This exposition was by far the greatest effort on the part of the Manufacturers and the steel industry to co-operate in each other's history. A complete list of exhibitors is as follows:

Alfred Box & Company
Allen Bradley Company
Alliance Machine Company
Allis Chalmers Mfg. Co.
Appleton Electric Company
The Andresen Company
Automatic Reclosing Circuit Breaker Company
American Engineering Co.
Earl B. Beach Company
Baker R & L Company
Bartlett Hayward Company
Benjamin Electric Mfg. Co.
W. A. Bittner Company
Bussman Manufacturing Co.
Bacharach Industrial Instrument Co.
Carbo Oxygen Company
Central Electric Company
Chicago Fuse & Mfg. Co.
Chicago Pneumatic Tool Co.
Corliss Carbon Company
Crocker Wheeler Company
Crouse Hinds Company
Cutler Hammer Mfg. Co.
The Cutter Company
The Calorizing Company
Delta Star Electric Company
Detrick Arch Company
Doubleday Hill Electric Co.
Dravo Doyle Company
Duquesne Light Company
Eastman Graf Company
Economy Fuse & Mfg. Co.
Edison Storage Battery Co.
Electric Controller & Mfg. Co.
The Electric Journal
Electric Materials Company
Electric Service Supplies Co.
Electric Storage Battery Co.
Electrical World
Fairbanks Morse Company
Fuels and Furnaces
Fuller Lehigh Company
Farrell Foundry & Machine Co.
General Electric Company
The Hayward Company
Herr & Harris Company
Ludwig Hommel & Company
Hyatt Roller Bearing Co.
Homestead Valve Mfg. Co.
Homer Commutator Company
Iron City Electric Company
Jos. Jacques
Johns Manville Company, Inc.
Keystone Lubricating Co.
H. Kleinhans Company
Lakewood Engineering Co.
J. Frank Lanning Co.
Laughlin & Barney Machy. Co.
Midwest Air Filter Company
Moloney Electric Company
Monitor Controller Company
Morgan Engineering Company
Mutual Electric & Machine Co.
Mutual Foundry & Mach. Co.
W. A. McCombs Company
McGraw-Hill Company
C. H. McCullough Eng. Co.
National Carbon Company
National Electric Mfg. Co.
National Lamp Works of G. E. Company
New Departure Mfg. Co.
Nichols-Lintern Company
Norma Company of America
Ohio Electric & Controller Co.
Okonite Wire & Cable Co.
Otis Elveator Company
Packard Electric Company
Pawling-Harnischfeger Co.
Pittsburgh Electric Fur. Corp.
Pittsburgh Transformer Co.
Pyle National Company
Pittsburgh Elec. & Mach. Wks.
Payne-Dean, Ltd.
Reed Air Filter Company
Railway & Industrial Eng. Co.
Republic Flow Meter Company
H. Lee Reynolds Company
Robinson Ventilating Co.
Rollway Bearing Company
Rutherford & Uptegraff
Reliance Electric & Eng. Co.
Rowan Controller Company
The Sharples Specialty Co.
Square D Company
SKF Industries, Inc.
Standard Underground Cable Company
Stroh Steel Hardening Process Company
The Superheater Company
Shepard Electric Crane & Hoist Co.
Wm. Swindell & Company
Thermoid Rubber Company
Thomas Flexible Coupling Co.
Tool Steel Gear & Pinion Co.
Trumbull Electric Mfg. Co.
Thompson Electric Co.
Union Electric Company
U. S. Graphite Company
V. V. Fittings Company
Vulcan Soot Cleaner Company
Western Electric Company
Westinghouse Elec. & Mfg. Co.
Westinghouse Lamp Company
West Penn Power Company



General views Iron and Steel Exposition.

TECHNICAL SESSIONS

The technical sessions were the best attended in the history of the Association of Iron and Steel Electrical Engineers.

The program was as follows:

MONDAY—10:00 A. M.

Blue Room — William Penn Hotel.

R. S. Shoemaker, President — Presiding Officer.

Address of Welcome—By R. S. Shoemaker.
Address of Welcome—Mayor W. A. Magee.
Report of Secretary—F. W. Cramer.
Report of Standardization Committee—F. W. Cramer.
Report of Electrical Development Committee—E. S. Jefferies.
Report of Safety Committee—Walter Greenwood.
Report of Special Bearings Committee—D. M. Petty.
Report of Papers Committee—S. S. Wales.
Report of Membership Committee—W. S. Hall.
Report of Combustion Committee—G. R. McDermott.
Report of Iron and Steel Exposition Committee — W. S. Hall.
Report of Banquet Committee—A. J. Standing.
Report of General Arrangements Committee—A. C. Cummins.
Report of Finance Committee—R. B. Gerhardt.
Report of Electric Furnace Committee — George H. Schaeffer.

TUESDAY—9:30 A. M.

Duquesne Garden.

John C. Reed, Past President — Presiding Officer.

Adjustable Speed Sets for Rolling Mills—By L. A. Umansky, General Electric Company, Schenectady, N. Y.

11:00 A. M.

Combustion Control — By E. G. Bailey, Bailey Meter Company, Cleveland, Ohio.

WEDNESDAY—9:30 A. M.

ELECTRIC HEATING FURNACE DAY.

Geo. H. Schaeffer, Second Vice President—Presiding Officer.

Medium and Low Temperature Applications — By E. A. Hurme, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

10:00 A. M.

Medium Temperature Furnace Installations — By C. F. Cone, The Hagen Corporation, Pittsburgh, Pa.

10:30 A. M.

Electric Melting Furnaces—By J. A. Seede, General Electric Company, Schenectady, N. Y.

11:00 A. M.

Electric Heating with Special Reference to Central Stations—By E. D. Sibley, Metropolitan Edison Company, Reading, Pa.

11:30 A. M.

Electric Furnace Installations at the Van Dorn Iron Works—By R. S. Sawdey, Van Dorn Iron Works, Cleveland, Ohio.

THURSDAY—9:30 A.M.

A. C. Cummins, First Vice President—Presiding Officer.

Developments in Electric Repair Shop Practice — By A. C. Cummins, Carnegie Steel Company, Duquesne, Pa.

10:30 A. M.

Crane Hoists Limit Devices—By Walter Greenwood, Carnegie Steel Company, Youngstown, Ohio.

11:00 A. M.

The Slagging Producer in Steel Works — By H. K. Huessener, American Heat Economy Bureau, Pittsburgh, Pa.

12:00 A. M.

Machine Tools and Their Auxiliaries — By John F. Kelly, A. I. & S. E. E., Pittsburgh, Pa.

FRIDAY—9:30 A. M.

CENTRAL STATION DAY

S. S. Wales, Director — Presiding Officer.

The Steel Industry and the Electric Utilities — By Merrill Skinner, Duquesne Light Company, Pittsburgh, Pa., and F. D. Mahoney, West Penn Power Company, Pittsburgh, Pa.

Power in the Iron and Steel Industry in America — By Barton R. Shover, Oliver Bldg., Pittsburgh, Pa.

BANQUET

THURSDAY EVENING, SEPTEMBER 18, 1924
WILLIAM PENN HOTEL

The Nineteenth Annual Dinner commemorating the thirtieth anniversary of the application of electric motors for use in the manufacture of iron and steel was by far the greatest gathering in the history of the Association.

Over 750 members and guests attended this dinner and the remarks of the honored guests were enjoyed by all.

The guests of honor were as follows:

Taylor Allderdice, Vice President, National Tube Company.

F. B. Bell, President, Edgewater Steel Co.

E. J. Buffington, President, Illinois Steel Co.

L. H. Burnett, Vice President, Carnegie Steel Company.

H. P. Davis, Vice President, Westinghouse Electric & Manufacturing Company.

W. G. Clyde, Vice President, Carnegie Steel Company.

A. N. Diehl, General Superintendent Carnegie Steel Company, Duquesne, Pa.

A. C. Dinkey, President, Midvale Steel Company.

W. U. Follansbee, President, Follansbee Bros. Company.

William A. Magee, Mayor, City of Pittsburgh.

A. W. Thompson, President, Philadelphia Co.

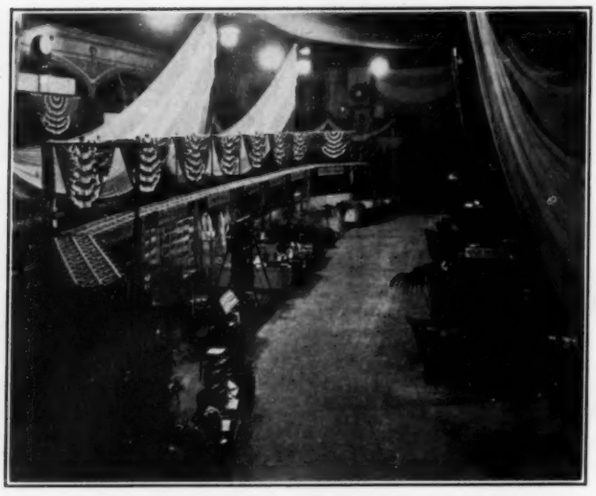
H. D. Williams, President, Carnegie Steel Co.

One feature in connection with the banquet which is of particular interest to the Association's membership was that one of our own members, Mr. L. H. Burnett, Vice President, Carnegie Steel Company, accepted the responsibilities of Toastmaster, and to write that his remarks were enjoyed is putting it very, very mild.

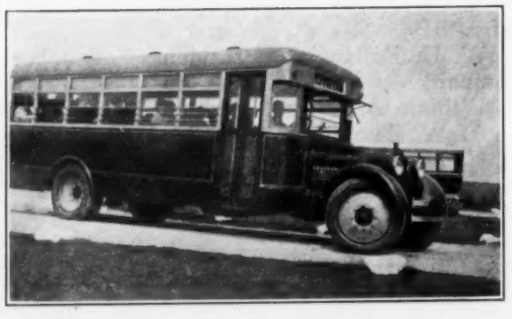
The guests who attended the banquet are as follows:

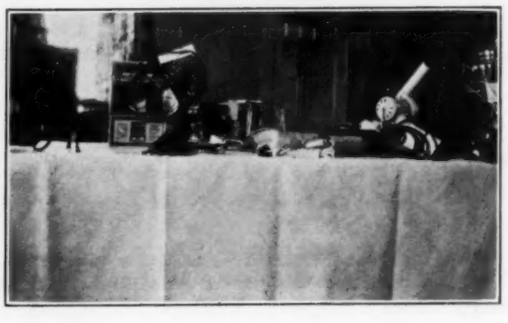
A. D. Adams, A. R. Anderson, A. L. Allewelt, J. Appleton, W. W. Adams, H. W. Allen, W. Anderson, S. M. Anson, guest of A. A. Anderson, Mrs. A. A. Anderson, P. E. Angle, F. A. Annett, Mr. Anderson, Walter Anderson.

Mrs. B. J. Ballard, B. J. Ballard, W. H. Boyce, O. M. Bercaw, H. A. Buzby, J. S. Boyd, R. L. Brown, A. L. Broman, F. J. Burd, J. J. Booth, G. M. Baker, F. C. Barrington, Mrs. F. C. Barrington, F. Barnard, J. L. Barker, Mrs. J. L. Barker, Earl B. Beach Co., Mr. Becket, Mrs. Becket, B. W. Blair, B. Boak, Mrs. B. Boak, D. S. Boreland, L. R. Botsai, Mrs. L. R. Botsai, Mrs. F. Brittingham, F. Brittingham, W. D. Brown, A. K. Bushman, H. Butt, Miss Butler, W. H.



Views Shanopm Country Club where ladies were entertained.





Burr, F. R. Burt, Orville Buys, D. C. Burroughs, Mrs. D. C. Burroughs.

J. T. Cooper, W. A. Corrigan, R. A. Corrigan, P. H. Conroy, V. A. Cronk, M. J. Conway, C. W. Chapelle, J. B. Crane, Mr. Conover, Fred Collins, T. Carroll, Thomas Carroll, Mrs. W. D. Cameron, W. D. Cameron, W. C. Candee, A. N. Cartwright, G. R. Carroll, R. F. Chaffin, B. D. Christian, J. S. Charles, Mrs. W. P. Chandler, Jr., W. P. Chandler, Jr., Mrs. Wm. Cleworth, Wm. Cleworth, C. D. Clapper, T. M. Cluley, John Cooper, H. M. Cook, C. F. Corman, F. B. Crosby, R. F. Crump, Mrs. George H. Criss, George H. Criss, G. L. Crosby, Mrs. G. L. Crosby, Cutter Electric & Mfg. Co., Mrs. A. C. Cummins, H. F. Cole, Mrs. H. F. Cole, Mrs. J. D. Crawbuck, J. D. Crawbuck, Paul Caldwell, Mrs. Paul Caldwell, John Cooper, A. B. Coffman, A. M. MacCutcheon.

E. Dowling, Mrs. R. B. Davenport, R. B. Davenport, Horace Dawson, Henry Davis, Mrs. C. C. Daly, C. C. Daly, D. L. Darnell, D. W. Dean, Mrs. A. W. Duncan, A. W. Duncan, Mrs. W. L. DeCoursey, W. L. DeCoursey, P. H. Diver, Mrs. James Donovan, James Donovan, Mrs. A. N. Diehl, A. C. Dyer, Mrs. A. C. Dyer.

W. H. Evans, F. D. Egan, Mrs. F. D. Egan, R. H. Ellis, Louis Ellman, Fred Ellman, Mrs. O. Evans, Oliva Evans.

E. Friedlaender, Mrs. E. Friedlaender, J. N. Forker, Mrs. J. N. Forker, H. C. Fetherling, H. J. Fisher, J. B. Flock, Mrs. J. B. Flock, Mr. Ferguson, Gordon Fox, Mrs. Gordon Fox, H. C. Fairbanks, N. E. Falkenstein, Mrs. W. E. Falkenstein, W. E. Falkenstein, F. R. Fishback, A. J. Freyn, Mr. Fish, T. J. Fleisher, C. J. Frisbee, Mrs. R. J. Feuchter, R. J. Feuchter, Walter Flanagan, Mrs. Walter Flanagan.

J. E. Graf, T. C. Gerwig, Thomas R. McGinnis, L. W. Gumm, Mrs. L. W. Gumm, L. H. Gaylord, Mrs. E. J. Gove, E. J. Gove, T. R. Grant, D. Galusha, J. M. Graves, Mrs. J. M. Graves, D. Geeseman, Mrs. D. Geeseman, Mrs. G. I. Gilson, G. I. Gilson, H. S. Gland, Walter Greenwood, Mrs. Walter Greenwood, Miss Greenwood, J. G. Griffith.

Mrs. E. A. Hurme, E. A. Hurme, G. W. Hall, Walter Hass, C. W. Hickle, W. T. Holmes, Mrs. W. T. Holmes, A. G. Hoffman, Mrs. A. G. Hoffman, E. L. Hough, Mrs. E. L. Hough, Henry Harris, W. O. Hern, Henry G. Hopkins, Mrs. Henry G. Hopkins, Mrs. J. D. Hiles, D. Hall, Ed. Harry, E. A. Harrar, R. Harry, B. T. Hare, L. W. Heller, R. E. Hellman, Mrs. R. E. Hellman, L. J. Hess, J. D. Hiles, Jr., A. B. Holcomb, Mrs. A. B. Holcomb, A. B. Holcomb guest, A. B. Holcomb guest, Ludwig Hommel, A. F. Hovey, F. O. Hoyt, Mrs. C. H. Hunt, C. H. Hunt, J. E. N. Hume, H. M. Hitchcock, R. O. Herbig.

J. M. Ireland, Mrs. J. M. Ireland.

H. J. Jefferson, F. W. Jessop, Mrs. F. W. Jessop, Mrs. J. A. Jackson, J. A. Jackson, S. Jefferies, Jos. Jelley, R. T. Johnson, R. T. Johnson guest, R. T. Johnson guest, R. T. Johnson guest, Catherine Jones, P. S. Jones, Mrs. P. S. Jones, E. W. Judy, Mrs. E. W. Judy, Mrs. E. S. Jefferies, E. S. Jefferies, W. W. Jackson.

Mrs. J. F. Kelly, Mrs. E. E. Knox, E. E. Knox, W. C. McKibben, Mrs. W. C. McKibben, Owen Kraft, G. W. Knight, Mr. Kaylor, Mrs. F. H. Kittredge, F. H. Kittredge, R. H. Keil, D. J. Kendall, A. F. Kenyon, W. C. Kennedy, L. J. Kerlin, W. G. Kiefer, Mrs. W. G. Kiefer.

J. Ralph Lewis, J. R. Lewis guest, Mrs. J. Ralph Lewis, Mrs. J. R. Lewis guest, E. F. J. Lindberg, Mrs. Saul Lavine, Saul Lavine, E. S. Lancester, Mrs. E. S. Lancester, H. O. Lewis, R. E. Lewis, J. V. Long, Mrs. J. V. Long, Lakewood Engineering Co., W. F. Lewis, J. M. Lenhart, H. A. Lewis, H. N. Lucas, J. R. Lewis, Mrs. J. R. Lewis, J. R. Longabaugh, R. M. Leech, George Little, Mrs. George Little, T. B. Little, William Lintern, Mrs. William Lintern, Mrs. F. E. Leahy, F. E. Leahy.

Mrs. J. J. Maloney, J. J. Maloney, George McFeaters, Mrs. George McFeaters, Mrs. J. M. Moore, Mrs. H. M. McLain, O. H. Meineke, Miss McIntyre, Mrs. T. P. McGinnis, C. T. Moyer, Henry Molz, Mrs. Henry Molz, Mr. Meharg, C. J. Mundo, Mrs. C. J. Mundo, Miss Mann, T. D. Montgomery, Mrs. R. L. McIntosh, Mr. McDermott, R. McIntosh, Mrs. Meksel, Mr. Meksel, Mr. McGrail, Mrs. McGrail, W. I. Moore, R. A. McCarthy, H. E. McCoy, Mrs. H. E. McCoy, F. D. Martin, Frank McWilliams, J. H. McLaurin, W. S. Michael, H. S. Michael, J. S. Murray, Mrs. J. S. Murray, C. J. Moloney, C. A. Magee, Jos. McKinley, Walter McClelland, Mrs. Walter McClelland, Mrs. E. H. McGuirk, C. McCullough, John Matthewson, Mrs. John Matthewson, Norma Matthewson, J. G. McNeely, Mrs. J. G. McNeely, L. Morron, T. C. McDermott, Mrs. T. C. McDermott, R. A. MacGregor.

C. C. Norstrum, H. G. Nichols, Mrs. S. G. Norton, National Carbon Co., National Carbon Co. guests.

E. C. Otto, J. A. Oartel, J. H. Overpeck, Mrs. J. H. Overpeck, Mr. Owen.

C. W. Post, A. G. Pierce, F. D. Paulin, E. L. Pittinger, George Pfeffer, J. B. Price, Charles Proudfoot, L. I. Playfair, A. G. Place, J. T. Peden, Mrs. J. T. Peden, C. F. Pittiman, F. S. Paxson, W. B. Pierce, W. H. Purcell, C. F. Pittman.

Mrs. G. W. Quentin, G. W. Quentin.

Lillian Ryon, J. S. Rowan, George W. Richardson, E. C. Ryan, A. W. Ramsey, Miss Helen Robinson, M. S. Robinson, H. S. Robinson, R. Rainsford, Mrs. A. W. Robertson, A. W. Robertson, A. L. Reichert, Mrs. A. L. Reichert, J. S. Roman, R. H. Roughen, Mrs. R. H. Roughen, Mrs. H. E. Ransford, H. E. Ransford, L. A. Roberts, F. J. Russell, Julian Roe, S. Russell, Jr., L. R. Rankin, Mrs. L. R. Rankin, Mrs. H. S. Richardson, H. S. Richardson, R. B. Rairigh, James A. Riles, Mrs. James A. Riles.

S. B. Shrontz, O. V. Schaum, Mrs. W. L. Springle, W. L. Springle, B. G. Street, Mrs. W. T. Snyder, W. T. Snyder, V. K. Stalford, A. J. Sorem, M. E. Skinner, Mrs. M. E. Skinner, Mrs. H. E. Slack, H. E. Slack, C. A. Swartz, Mrs. C. A. Swartz, R. J. Schutte, Mrs. R. J. Schutte, H. Y. Stuckey, G. E. Stoltz, E. S. Simkine, Don Spackman, H. S. Stockdale, A. C. W. Smith, A. A. Stewart, Mrs. A. A. Stewart, G. E. Stack, A. W. Soderberg, J. C. Snyder, D. K. Starbuck, S. R. Shepard, G. Sutherland, A. H. Swartz, E. C. Stone, Mrs. E. C. Stone, Fred Schnure, R. R. Stone, Mrs. R. R. Stone, C. A. Stover, Mrs. C. A. Stover.

Mr. Thompson, Mrs. Thompson, F. A. Tremellen, Mrs. F. A. Tremellen, W. B. Trainer, P. G. Tweed, T. D. Tindle, C. D. Taylor, C. D. Taylor guest, R. E. Thomas, Mrs. A. J. Thompson, A. J. Thompson.

D. J. Underwood, E. L. Upp, Mrs. E. L. Upp, L. A. Umansky.

Alma Voelkers, E. P. VanKirk, Mrs. E. P. VanKirk, R. Voorhees, Mrs. R. Voorhees.

F. A. Wiley, Miss Leile Wiley, J. H. Wagner, Mrs. W. H. Warren, W. H. Warren, W. B. Wallis, R. H. Wright, W. F. Wettengel, E. M. Wise, G. P. Wilson, M. A. Watterson, Miss M. G. Woodside, F. H. Woodhull, K. G. White, R. O. Wertz, M. B. Wilson, Mrs. M. B. Wilson, J. D. Wright, Mrs. H. G. Weeks, H. G. Weeks, R. G. Widdows, Mrs. R. G. Widdows, A. J. Whitcomb, F. C. Watson, Mrs. F. C. Watson, R. O. Watson, Mrs. R. O. Watson.

F. C. Young, E. H. Younglove.

About 150 additional guests also attended, but registered too late to appear in the seating list.

LADIES ENTERTAINMENT

The members of the Pittsburgh Section are to be congratulated upon the wonderful program which was arranged for the visiting ladies.

The program was as follows:

MONDAY, SEPTEMBER 15th.

8:00 A. M.—Registration at Wm. Penn Hotel (Lobby).
2:30 P. M.—Cards—Blue Room of Wm. Penn Hotel.
6:00 P. M.—Dinner at Nixon Restaurant.
8:30 P. M.—Dance at Ball Room of Wm. Penn Hotel (17th Floor).

TUESDAY, SEPTEMBER 16th.

11:00 A. M.—Guests of Westinghouse Electric & Mfg. Company at Pittsburgh Country Club.

6:00 P. M.—Dinner at Venice Restaurant.

WEDNESDAY, SEPTEMBER 17th.

11:00 A. M.—Guests of Duquesne Light Company and West Penn Power Company at Shanopins Country Club Views.

8:15 P. M.—Theatre Party.

THURSDAY, SEPTEMBER 18th.

11:00 A. M.—Visit to Plant of H. J. Heinz Company (Home of 57 Varieties).

6:30 P. M.—Concert in Reception Room of Wm. Penn Hotel.

7:00 P. M.—Nineteenth Annual Banquet commemorating the thirtieth anniversary of the adoption of electric motors for use in the manufacture of iron and steel.—Wm. Penn Hotel.

10:30 P. M.—Grand Ball.

ELECTION OF OFFICERS

The tellers, Mr. George Richardson, Walter Greenwood, A. C. Duncan, reported the count of the ballots cast in the election for officers for the ensuing year. The results were as follows:

President—A. C. Cummins, Electrical Superintendent, Carnegie Steel Company, Duquesne, Pa.

First Vice President—Mr. George H. Schaeffer, Electrical Engineer, Carpenter Steel Company, Reading, Pa.

Second Vice President — S. S. Wales, Electrical Engineer, Carnegie Steel Company, Pittsburgh, Pa.

Secretary—F. W. Cramer, Assistant Electrical Superintendent, Bethlehem Steel Company, Johnstown, Pa.

Treasurer, James Farrington, Electrical Superintendent, Wheeling Steel Corporation, Steubenville, Ohio.

Directors

G. R. McDermott, Asst. Chief Engineer, Illinois Steel Co., Chicago, Ill.

W. S. Hall, Electric Engineer, Illinois Steel Company, Chicago, Ill.

C. B. Skelly, Electrical Superintendent, American Steel & Wire Company, Cleveland, Ohio.

A. J. Standing, Electrical Superintendent, Bethlehem Steel Company, Saucon Plant, Bethlehem, Pa.

J. E. Harrell, Assistant Chief Electrician, Fairfield Works, Tennessee Coal, Iron & Railroad Company, Fairfield, Ala.

Committees for Nineteenth Annual Convention.

General Arrangements — A. C. Cummins, Chairman; A. C. Dyer, J. R. Doyle, R. B. Gerhardt, A. F. Jones and G. W. Quentin.

Registration Committee—Geo. H. Schaeffer, Chairman; E. A. Hurme, J. H. Albrecht, J. J. Bangert, T. B. Little, W. H. Williams, J. M. Ireland, T. B. Moffatt, W. P. Chandler, W. S. Hall, Paul Jones, F. W. Cramer, A. G. Pierce, E. S. Jefferies, R. H. Rhoades, R. E. Lewis, F. D. Egan and F. E. Leahy.

Banquet Committee—A. J. Standing, Chairman; J. F. Kelly, L. O. Morrow, W. H. Williams, H. E. Davis, J. J. Booth, A. R. Lintern, Paul Caldwell, W. B. Connally, W. H. Burr, E. A. Hurme and A. C. Dyer.

Inspection Trip — James Farrington, Chairman; A. W. Duncan and J. J. Booth.

Ladies' Committee — Mrs. E. S. Jefferies, Chairman; Mrs. W. P. Chandler, Mrs. R. S. Shoemaker, Mrs. E. Friedlaender, Mrs. Frank Kittredge, Mrs. Ralph Watson, Mrs. A. J. Standing, Mrs. B. W. Gilson, Mrs. Grant Armor, Mrs. Richard Schutte, Mrs. A. C. Cummins, Mrs. Paul Caldwell, Mrs. W. D. Cameron, Mrs. F. E. Leahy, Mrs. E. A. Hurme, Mrs. H. C. Mosley, Mrs. A. G. Place, Mrs. G. W. Quentin and Mrs. M. E. Skinner.

Monday Night's Entertainment — A. J. Standing, Chairman; Mrs. J. M. Ireland, E. A. Hurme, Saul Lavine, H. Lee Reynolds, A. C. Cummins, E. W. Harry, T. J. Fleischer, A. H. Bergendahl, E. Friedlaender, George Gadsby, F. E. Leahy, R. L. McIntosh, C. J. Maloney, E. Swift Newton, E. S. Stickle, J. R. Lewis, J. J. McQuillen, R. M. Hussey, B. J. Ballard, George Criss, Ludwig Hommel, M. E. Skinner, A. C. Duncan, W. S. Hall, Gordon Fox and R. G. Widdows.

Railroad Committee—John R. Doyle.

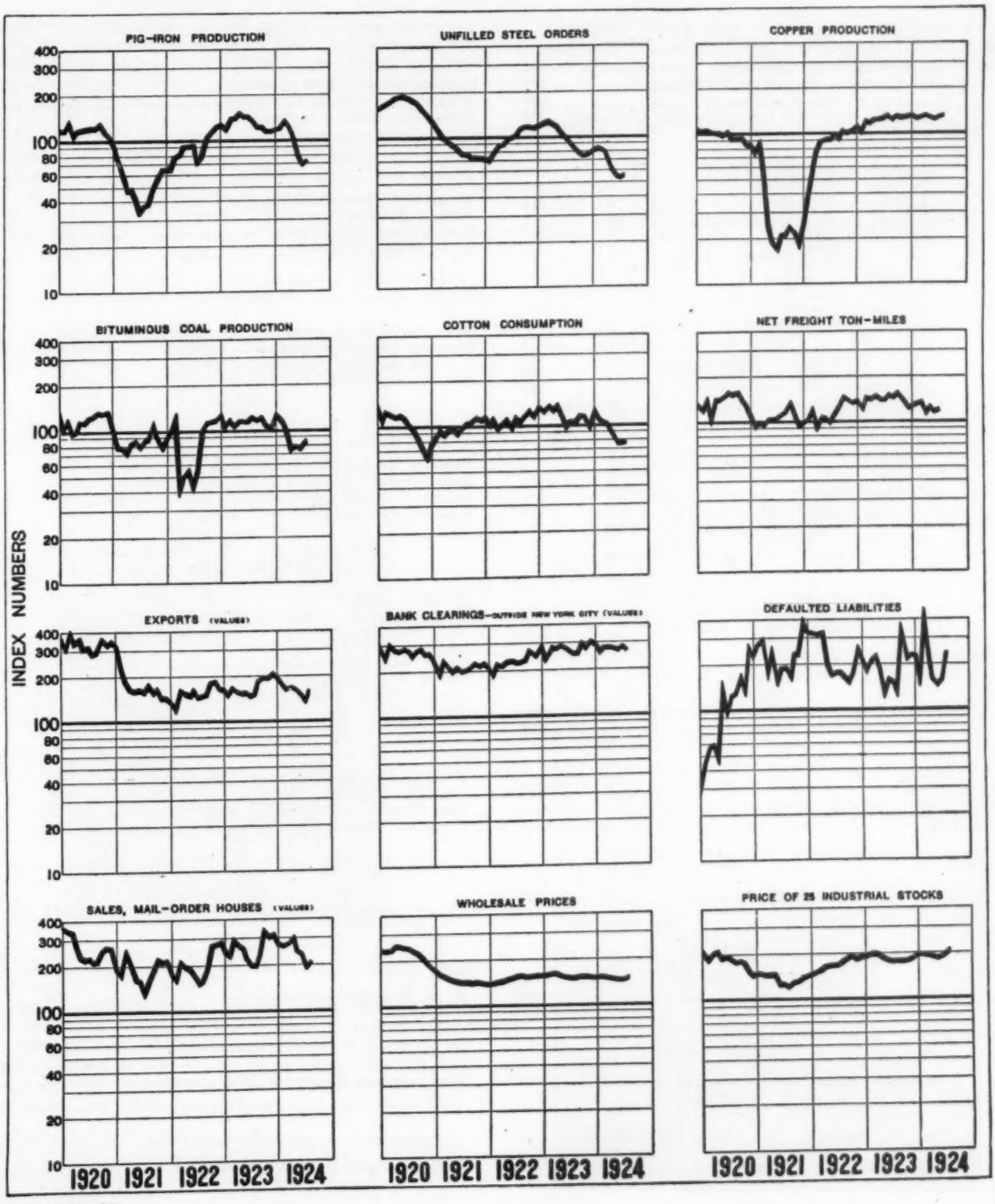
Iron and Steel Exposition — John F. Kelly, Chairman; A. R. Lintern, Floor Manager, and A. C. Cummins, Power.

Corrections September Issue

Booths Nos. 66 and 67 at the exposition contained various models of Morgan Engineering Company special cranes, and in addition had the new Morgan Wackerly limit stop on display. This stop was connected up to a motor and practical working demonstrations of same were made. In addition to this, different types of crane controllers were also exhibited. This display was in charge of J. J. McQuillen, Pittsburgh representative; John Kloos, of the service department; R. C. Voorhies, of the electrical department, and F. H. Barnard from the sales department.

SURVEY OF CURRENT BUSINESS

Prepared in the Bureau of the Census



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*Electrification of Tata Iron Works at Jamshedpur, India**

By S. GHOSH†

I propose first of all to tell you something in regard to The Tata Iron & Steel Company. Of the numerous industrial enterprises on which Mr. Tata had embarked, the manufacture of iron and steel was one and by no means the least important.

In 1875 Mr. Tata began exploring in order to find suitable raw materials located in close enough proximity to each other to make the venture an economical success. It is unnecessary to detail too minutely all the preliminary work that was done. But it is sufficient to say that after having consulted many experts in other countries, and after having spent considerable sums of money on exploration work, the venture was so far advanced in 1907, and the results were so satisfactory, that it was decided

MR. S. GHOSH
Electrical Engineer, Tata Iron & Steel Co., Jamshedpur, India.

to form a company, and begin the manufacture of iron and steel. Unfortunately, before all of the spade work had been finished, Mr. Tata died, (a photograph of his statue is shown in Fig. 1), but his sons, having followed closely all of his investigations, and having the courage of their father, carried out his program without interruption.

In 1907 they formed a joint stock company with a strong and influential board, inviting the public to subscribe the necessary capital. The company was named "The Tata Iron & Steel Company, Ltd.," and was formed for the purpose of creating in India blast furnaces, steel furnaces, rolling mills, coke ovens and their accessories

FIG. 1.—*Photograph of the statue of late Mr. J. N. Tata, the founder of the Tata Iron & Steel Company.*

necessary for the manufacture of pig iron and steel in its various forms. At present, about 1 per cent of the whole of the world's product of steel ingots, which is about 50,000,000 tons per year, is produced by The Tata Iron & Steel Company, Ltd.

The steel which is manufactured by this company is chiefly used in the making of rails, cars, buildings, bridges, etc. A very great quantity and variety of equipment is required to produce this vast tonnage. The man-

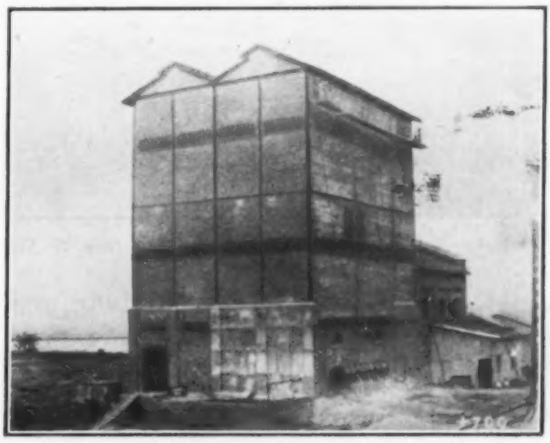

FIG. 2.—*The sulphuric acid plant of the Tata Iron & Steel Company.*

*This paper is presented for our memberships consideration as it represents foreign electrical practices.

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agement of the Tata Iron & Steel Company has been quick to realize the advantages of electric drive. Some of the advantages are, ease of control, increased safety, increased production and economy; therefore, electric drive is now applied to most machinery used in the production of steel. The steel industry represents one of the largest fields for the endeavors of electrical

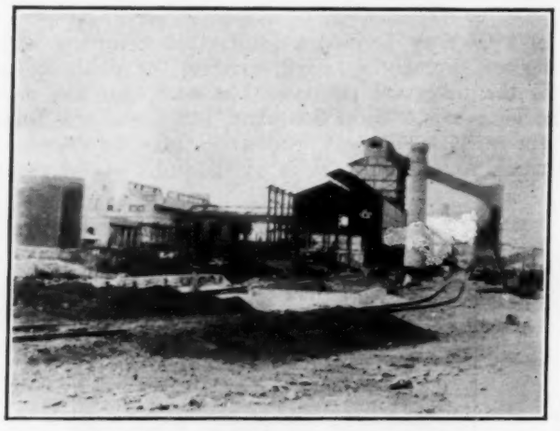

FIG. 3.—*The Wilputte coke ovens of the Tata Iron & Steel Company.*

engineers. More electric power is being used in the production of steel than in that of any other commodity.

To reduce the ores to pig iron, a large quantity of coke is required, hence the steel company having to meet this vast demand, have installed some of the biggest and most up-to-date plants for producing coke and other by-products of coal. The coke plant consists of 180 Kopper non-recovery coke ovens and a battery of 50 Kopper's by-product coke ovens which produces coal tar, sulphate of ammonia and gas, besides coke. There is also a Simon Carve sulphuric acid plant for manufacturing sulphuric acid for con-

FIG. 4.—*New blast furnaces of the Tata Iron & Steel Company.*

verting the ammoniacal liquor into sulphate of ammonia (Fig. 2). In addition to the above, three batteries of 50 ovens each of the Wilputte type are also in operation at present in connection with the new extensions to the works.

In handling this great amount of coal from the wagon to the finished coke, there is a large equipment of electrical machinery which is both labor-saving as well as efficient in its control, a brief description of which will not be out of place. In the Wilputte Coke Ovens, as shown in Fig. 3, the coal is delivered through a hopper to a belt conveyor system worked by electric motors and conveyed to the breaker mill. Here, foreign material in the coal, such as

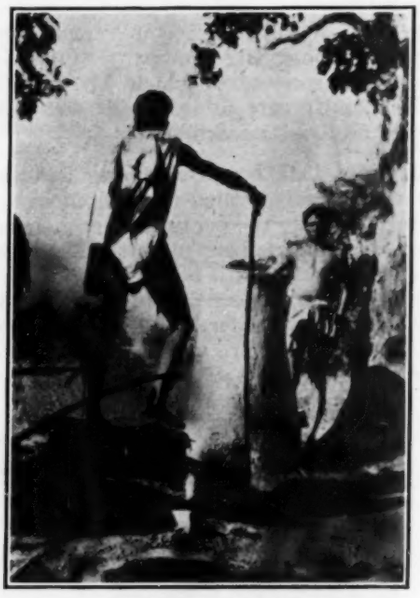

FIG. 5.—*Primitive type of blast furnace.*

iron, is separated by the magnetic separator. The coal is now dumped into bins electrically from which it goes to the pulverizer, which is driven by a 3000-volt induction motor. The pulverized coal is now dumped in a large bin by another electrically driven belt conveying system. The ovens are charged by a charging lorry which is hauled up and down the whole plant

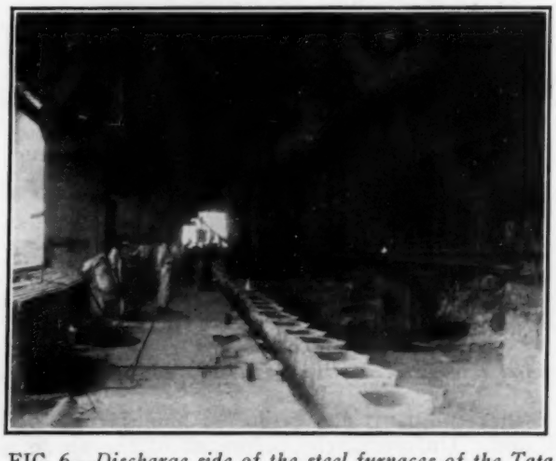

FIG. 6.—*Discharge side of the steel furnaces of the Tata Iron & Steel Company.*

electrically. The contents of the ovens, both before and after carbonization, are levelled and cleared respectively by an electrically operated coke pusher equipment.

Volatile gases, tar, etc., are again controlled by a time operated electric motor, placed in a suitable location in the gas mains.

The supply of gas and air to the ovens in proper sequence is controlled by a clock-operated, and perfectly automatic, electrical control system. To separate the tar, there is another electrically driven pumping equipment. For safety in operation, there are several push button control stations at various points

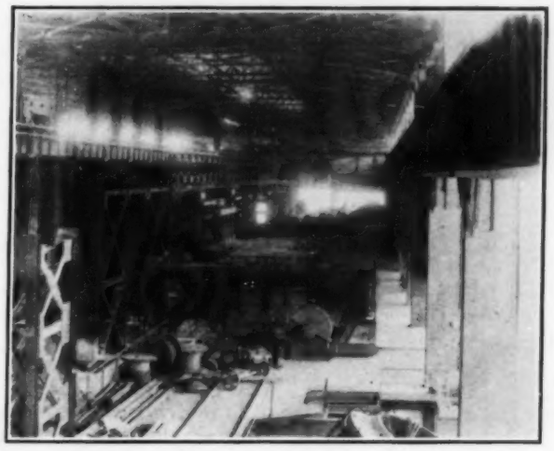

FIG. 7.—*Duplex and steel plant of the Tata Iron & Steel Company.*

for the conveyor system. So that from the foregoing you will see how electricity has entered in the manufacture of the fuel for the blast furnace plant.

This plant consist of five blast furnaces. Out of these, three are of 300 ton capacity and two of 500 ton capacity each.

In the operation of the new blast furnaces, shown in Fig. 4, of the Tata Iron & Steel Company, practically every process, such as the controlling of the bells and the driving of the pumps, is also accomplished most efficiently by the use of electricity. The limestone, coke and other raw materials necessary in the production of the pig iron, which are brought to this plant, are lifted to the blast furnace by an elec-

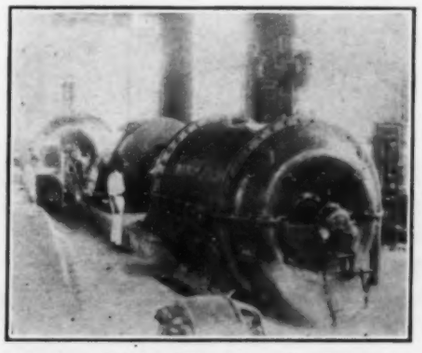

FIG. 8.—*Blower house for Bessemer converters of the Tata Iron & Steel Co.*

trically operated skip hoist. A primitive type of blast furnace is shown in Fig. 5.

From the blast furnace, the molten metal is taken to large storage vessels, known as mixers, and here the metal is stored until required by the open hearth furnaces or Bessemer converters, as shown in Fig. 6 and Fig. 7. These mixers are rotated into position for pouring by electricity. The steel works plant consists of one 300 ton furnace, called the mixer, and seven stationary open hearth furnaces. Out of these, four are of about 50 ton and three of 70 ton capacity each, per heat. In the extensions to the steel works there are two 25 ton Bessemer converters and two 200 ton tilting furnaces together with a 1200 ton mixer.

FIG. 9.—*Platform side of the steel furnaces of the Tata Iron & Steel Company.*

In addition to these a six ton electric furnace is also in course of erection.

Fig. 8 shows the blower house equipment for Bessemer converter. This blower is driven by a mill type induction motor of 3600 hp., 750 rpm. and 3000 volts. A ladle into which the charge is poured is taken to the open hearth furnace or Bessemer converter by electric power, and its contents are poured into the furnace by an electric crane. Scrap iron and ore or limestone, which are added to the charge in the open hearth furnace, are placed in iron boxes; these boxes are seized by an electrically operated charging

FIG. 10.—*Electrically driven ingot bogie of the Tata Iron & Steel Company.*

machine, which, thrusting them into the furnace, empties its contents and withdraws the box; the arrangement is shown in Fig. 9. Electric power is used also to pour the molten metal from the 200 ton open hearth furnace into ladle, which is moved by a 150 ton electric crane to the pouring floor, where the molten metal is cast into ingots. As soon as the metal is partially solidified, an electrically driven stripper

removes the moulds from the ingots. Electrically operated hands, called soaking pit tongs, place these ingots in the heating furnace while they are still at a high temperature. The soaking pit crane delivers the hot ingots to an electrically operated tilting bogie which places them on an electrically driven roll table,

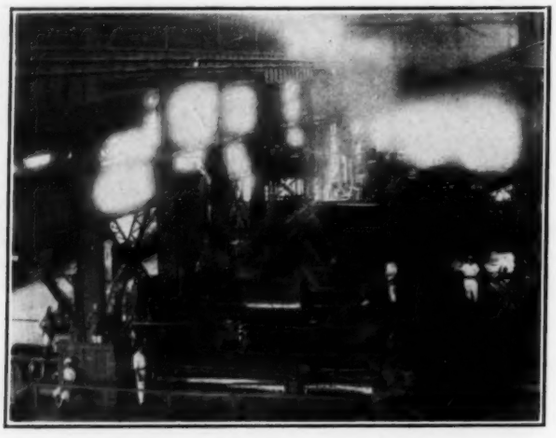

FIG. 11.—11,000 *and* 12,000 *reciprocating steam engines at the old blooming mill of the Tata Iron & Steel Co.*

which in turn carries the ingots in a proper position for entering the mills as shown in Fig. 10.

A great many of the present steel plants were put in operation before suitable electrical apparatus had been developed for their use. The main rolls are driven by large reciprocating steam engines which are often non-condensing. The original plant of the 40-in. blooming mill and 28-in. rail mill in the Tata Iron & Steel Company, which is also driven by large reciprocating steam engines of 11,000 and 12,000 hp. respectively, is shown in Fig. 11. These steam engines would be considered very wasteful at the present time but were the best apparatus obtainable when originally installed.

In 1905 motors were first applied in rolling mill drives. The original installation was made at the

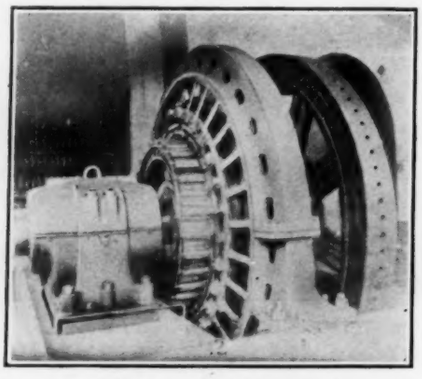

FIG. 12.—1,500 *hp. Westinghouse d.c. motor of the Edgar Thomson Works.*

Edgar Thomson Works, Bethlehem, U. S. A., consisting of two 1500-hp. Westinghouse d.c. motors connected to the main rolls of a light rail mill. One of these motors is shown in Fig. 12. Power for their operation was supplied by engine driven d.c. generators in the power house. These motors were non-reversing. At one time it was believed by many engineers that reversing motors could not be designed to meet this condition. Later developments have proved that these fears were groundless.

In 1907 the Westinghouse Company furnished an 8,000 hp. reversing mill drive to the Illinois Steel Com-

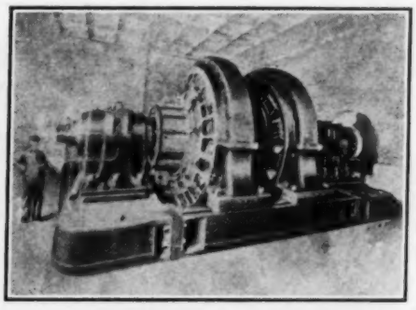

FIG. 13.—8,000 *hp. reversing mill drive motor of the Illinois Steel Company.*

pany, as shown in Fig. 13. This drive was to operate a 30-in. Universal plate mill at the South Chicago plant of the Illinois Steel Company. This was the first reversing mill drive in the United States and the second in the World. This equipment also was successful and is still giving good service.

The success of these two installations proved that electrical apparatus was both dependable and efficient. Progress was very rapid from this time. Within the last 20 years electric drive has been applied in almost every operation in steel plants.

When steel plants first started to electrify, the generating units which they used were of small capacity and were usually engine driven. The increasing use of electrical apparatus in the mills has made it necessary to greatly enlarge the generating stations. The power plant has now become a very important part of the entire plant and demands a great deal of attention of the engineering forces of the plant.

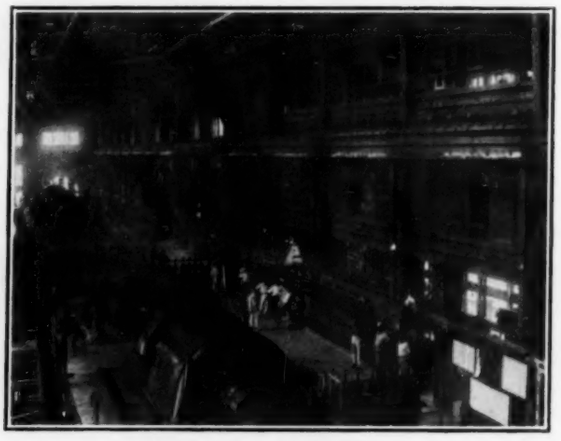

FIG. 14.—*Interior of the new power station of the Tata Iron & Steel Company.*

The present trend is toward the use of steam turbine driven generators in power houses. The new power plant of the Tata Iron & Steel Company, consisting of two 10,000 and one 5,000 kw. turbo alternators supplied by the General Electric Company, America, is shown in Fig. 14. Fig. 15 shows the in-

terior of the old power plant. The total capacity of both the old and new power stations of the Tata Iron & Steel Company is 37,700 kw.

The boilers of the Tata Iron & Steel Company shown in Fig. 16 are equipped to burn either blast furnace gas or coal. Large turbine units have a very low water rate, but steel mill men are inclined to use small units. This is because continuity of service is of greater importance than economy in operation. They therefore use a number of small units so that the loss of one unit would not cripple the entire plant. With this system the spare units are smaller. The turbo generators now used in the Tata Iron & Steel Company range from 1,000 to 10,000 kw.

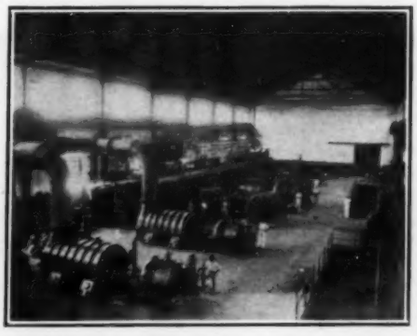

FIG. 15.—*Interior of the old power plant of the Tata Iron & Steel Company.*

One of the chief advantages of the electric drive in the Tata Iron & Steel Company lies in the fact that the power is generated in one power plant and transmitted over a wide territory with small losses. Steam would be made much more economical if the boilers could be located together, but the losses in transmission would more than offset any saving resulting from a centralized boiled plant. The peak loads of various mills overlap, and a much better load factor is obtained than if individual power stations were used. The total boiler capacity is, therefore, considerably reduced.

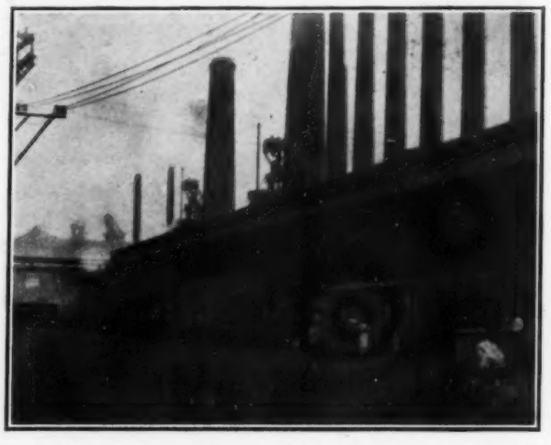

FIG. 16.—*The boiler house of the Tata Iron & Steel Co.*

The General Electric Company of America furnished one 5,600 hp. mill drive, capable of developing momentary peaks of 22,000 hp. at 50 rpm., to the Tata Iron & Steel Company. This motor is shown in Fig. 17. This drive is to operate the 40-in. blooming mill at the new steel works. It came into operation on the first of November, 1923, as an important feature in the greater extensions of this company, which, when complete, would take its place as one of the large steel producing works in the world. This mill is of the Mackintosh Hemphill type, with a productive capacity of 1,000 to 1,400 tons per diem, and is undoubtedly the biggest of its kind in Asia, as also an entirely new type of machinery. It will roll at once steel ingots into slabs for plate mill, blooms for rails, structural shapes, billets and roughed-out blanks for 20-in. and 24-in. beams.

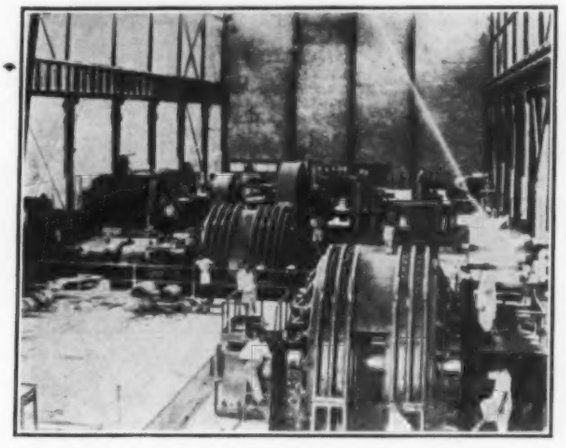

FIG. 17.—*Interior of the new blooming mill motor house 5,600 hp., d.c. motor. The flywheel set in background is 4,000 hp. induction motor direct coupled to three 2,000 kw., d.c. generators.*

A motor generator set which generates d.c. current for the main motor of the mill, is provided with a 50-ton flywheel. This flywheel, which is 14 ft. 6 in. dia., and runs at 375 rpm., is made up of three pieces — two solid steel discs with an annular ring forming the rim. The discs are each made in one piece, and, on account of their large diameter, special arrangements had to be made for their transport from the jetties at Calcutta up to Jamshedpur.

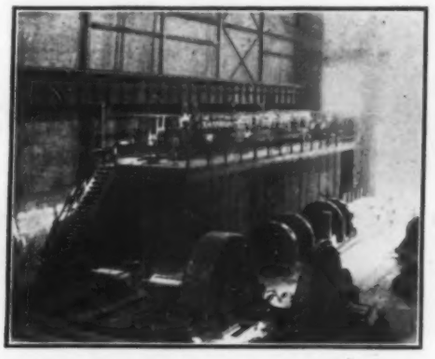

FIG. 18.—*Blooming and rail mill motor house switchboard of the Tata Iron & Steel Company.*

The flywheel motor generator set, as shown in background of Fig. 17, consists of three 2000 kw., d.c. generators, one 4000 hp. induction motor and one 100,000 lbs. flywheel, all mounted upon a common base.

The total weight of the motor generator set, including the flywheel, is approximately 487,000 lbs.

The control of this machine is essentially Illgner Ward Leonard system, by which the power input to the induction motor is equalized by means of the flywheel through the control of a slip regulator, and the

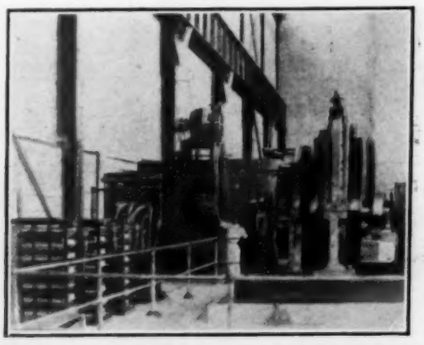

FIG. 19.—*Slip regulator for the fly wheel motor generator set of the Tata Iron & Company.*

speed and direction of the main mill motor is regulated by controlling the fields of the d.c. machines. Separate excitation is applied from a 250 volt exciter set for each of the motors and generators. The two motor fields are connected in series and three generator fields are also connected in series. The direction of rotation and the speed up to 55 rpm. on the mill motor is controlled by generator voltage. For speed above 55 rpm. up to a maximum of 120 rpm. the control is by means of motor field. The sequence of operation of the magnetic contactors handling these fields is governed by a pilot motor driven master controller. The principal feature of this controller is its automatic regularity in the control of the operation of the field conductors, thereby giving a uniform rate of

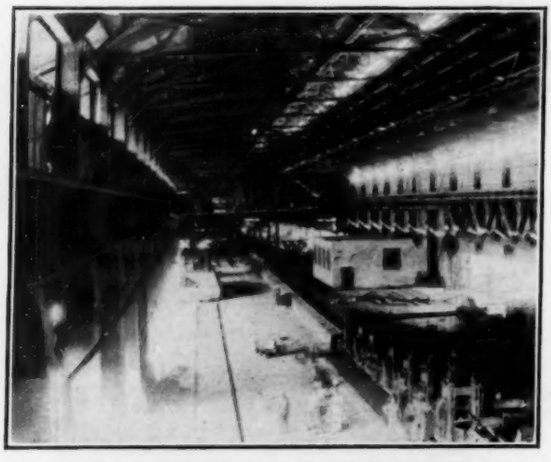

FIG. 20.—*Bar and billet mill of the Tata Iron & Steel Co.*

change in the speed of the mill, irrespective of the manipulation by the operator.

The control equipment for the 4,000 hp. induction motor driving the flywheel set, consists of two triple pole oil circuit breakers, one of which is used for normal operation of the flywheel motor generator set, and the other for plugging the induction motor in order to obtain a quick stop, and the operation is from a switch board of remote control system as shown in Fig. 18. The secondary control equipment for the induction motor consists of a liquid slip regulator shown in Fig. 19. This slip regulator is provided with a torque motor, the windings of which are connected to the secondaries of the series transformers located in

FIG. 21.—*Merchant mill of the Tata Iron & Steel Co. (In course of construction.)*

the line leading to the primary circuit of the main induction motor. The purpose of this torque motor is to adjust the position of the movable electrodes of the slip regulator so that the resistance of the secondary circuit of the induction motor driving the flywheel may be varied, and the speed of the set regulated so that an approximately constant input from the line to the induction motor will be maintained. As the load comes on, the speed of the set is decreased and the portion of the stored energy of the flywheel and the other rotating parts is transformed into useful work at the motor shaft. During light load, the fly-

FIG. 22.—*Plate mill of the Tata Iron & Steel Company.*

wheel is automatically accelerated and the rapidly fluctuating loads of the main mill motor are effectively prevented from reaching the incoming power line.

In order that the induction motor may be plugged to stop the flywheel set quickly, additional iron grid resistance is provided. This additional resistance is connected in series with the liquid slip regulator, and is necessary in order to limit the current which will

be drawn from the line when the induction motor is plugged.

The whole of the rolling process from the ingots to the finished blooms or slabs is done electrically.

The new rail mill of the Tata Iron & Steel Company which will come into operation very soon, is furnished with a G. E. C. 3150 hp., 80 rpm. reversing mill motor capable of developing momentary peaks of 15,500 hp. at 75 rpm. This reversing mill motor is exactly similar in design as in the 40-in reversing blooming mill.

FIG. 23.—*Main motor for plate mill of the Tata Iron & Steel Company.*

The continuous sheet bar and billet mill, shown in Fig. 20, will reduce the blooms into sheet bars and billets for the sheet mill. In this mill there is a 2300 hp., 375 rpm. mill type induction motor for the 24-in. mill and a 4,000 hp., 375 rpm. motor for the 18-in. mill.

For the 12-in. merchant mill, shown in Fig. 21, the main drive is a 2500 hp. mill type induction motor of 450/375/300 rpm., with a speed regulating set of 475 kva., 500 rpm. and 3,000 volts, and for the 8-in. merchant mill, the main drive is a 600 hp., 550/500/350 rpm. motor with a speed regulating set of 190 kva. and 750 rpm.

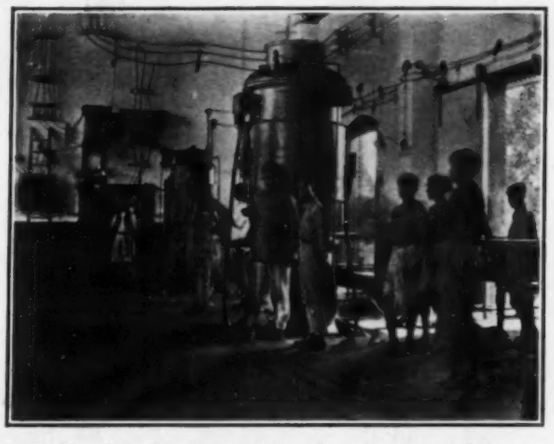

FIG. 24.—*Interior view of the river pumps at Subernrekha of the Tata Iron & Steel Company.*

The sheet mill will produce sheets to any widths up to 38 in. and of any thickness from ⅛ in. to 1/100th of an inch. The main drive is a 1500 hp., 250 rpm., 3000 volts mill type induction motor.

In the plate mill plates are produced from ⅛ in. to 1¼ in. thick in various widths up to 84 in. and various lengths up to 50 ft. The mill is driven by a 2,500 hp., 200 rpm., 3000 volts mill type induction motor. Figs. 22 and 23 show the plate mill and the main motor for this mill.

FIG. 25.—*Interior view of the town pumping station of the Tata Iron & Steel Company.*

The limit of application of electricity in the steel industry has not yet been reached. Improved processes, new applications, and the ever increasing demands for more efficient operation will keep the electrical engineers of this company always on the alert to meet new and exacting requirements.

The supply of water for the works and also for the large population living in the adjacent area is made by pumping from the Subarnarekha River which is at a distance of two miles. There are five Sulzer high lift pumps, each of 4,000,000 gallons capacity per diem at a head of 170 ft. These are driven by 250 hp., 3000 volts, 980 rpm. vertical type induction motors as shown in Fig. 24.

The town is supplied with water filtered by the Jewel filter system, and the water is pumped from the town pump house as shown in Fig. 25, to the central reservoir (Fig. 26), from where it is distributed. The town pumps are Sulzer's horizontal type pumps of 2,160,000 gallons per diem at a head of 205 ft., and are driven by induction motors of 145 hp.

FIG. 26.—*Central water reservoir of the Tata Iron & Steel Company.*

The Tata Iron & Steel Company at present possess 70 overhead electric cranes ranging from a capacity of three tons to 200 tons each.

The whole of the works has been supplied with electricity, and, wherever possible and convenient, motors are used. For example, in the foundry, machine shops, pattern maker's shop, etc., there are motors for blowers, planing machines, saws and other tool machines. Altogether there are 1300 motors in use in the whole plant now, ranging from ½ hp. to 5600 hp.

The lighting effect inside the works is carried out by means of about 7,000 lights. These consist of lights varying from 16 cp. to 1000 cp.

FIG. 27.—*D.c. town distribution station of the Tata Iron & Steel Company.*

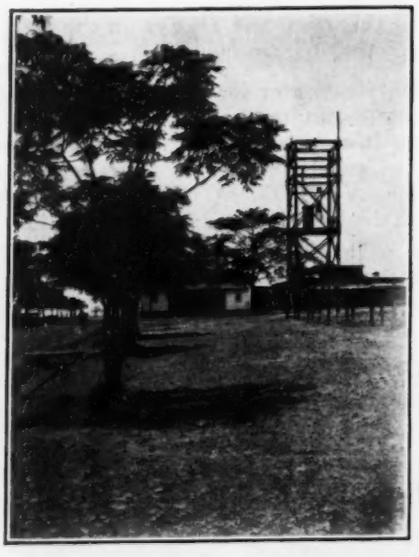

FIG. 28.—*Outdoor type transformer substation of a.c. lighting system of the Tata Iron & Steel Company.*

Fig. 27 shows the d.c. distribution station, and Fig. 28 the outdoor type transformer sub-station for a.c. lighting system in the town. These take care of about 1,500 fans and 6,000 lights that are in use in the town.

Fig. 29 shows one of the many towers carrying high tension feeders from the power house to different parts of the works and the subsidiaries. Fig. 30 shows a double rail mast for our transmission lines. The rails and cross arms of these masts were manufactured in our works at Jamshedpur.

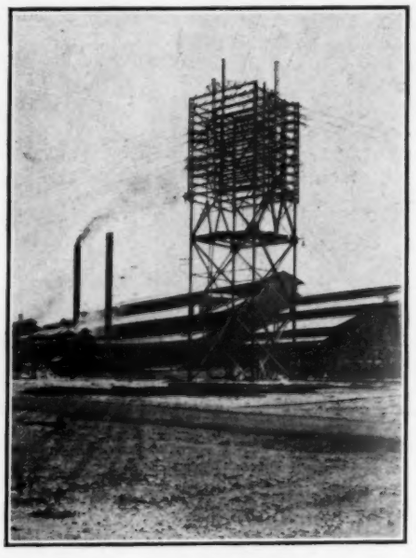

FIG. 29.—*High tension junction tower of the Tata Iron & Steel Company.*

FIG. 30.—*High tension double rail mast of the Tata Iron & Steel Company.*

Before I close, I would like to thank those gentlemen, who contributed to the success of this paper, especially the general manager of the Tata Iron & Steel Company, Ltd.

Pulverized Coal Used as Fuel in Sheet Mills

By JOHN GLEW*

IN one of the previous issues of the "Iron and Steel Engineer" some comments appeared comparing the subject of fuel economy of the present day with common practice of a decade ago. Time was when no record was kept as to amount of fuel necessary to produce the finished material. This condition obtained when coal was comparatively cheap and did not play the prominent part in production which it takes at present. As industry advances, however, new plants spring up increasing competition and this together with the ever increasing cost of fuels, makes it imperative for successful producers to get the most and best results out of the fuel used.

Past experience has demonstrated that to get the largest returns from coal it is necessary to pulverize it and fire it properly mixed with air as a "mechanical gas". This fact is accepted more and more by engineers and operators as is evidenced by the large number of pulverized coal installations that have been made in the iron and steel industry in recent years. The reason for this is not only that the maximum heat units can be recovered

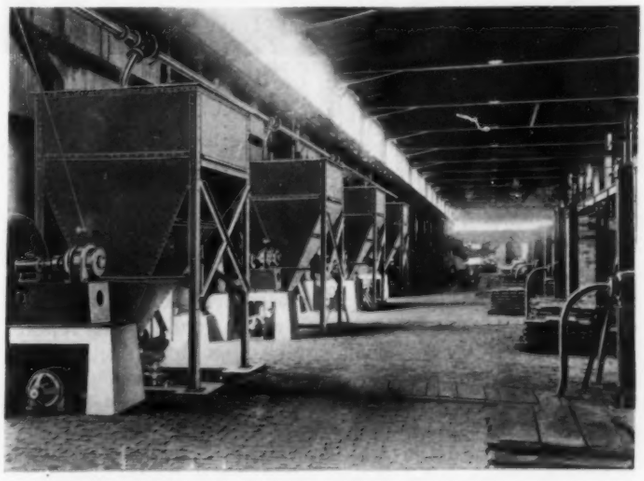

FIG. 1.

when coal is fired in the powdered form, but also that coals which, by reason of their chemical or physical characteristics, are absolutely worthless as a commercial fuel in their present state can be successfully used for firing boilers, metallurgical and industrial furnaces when pulverized.

It must not be assumed, however, that the coal which is cheapest in dollars and cents per ton is the most economical to use. Conditions in each plant must be studied and analyzed such as the product to be produced, the type of furnace and the grade of coal which will give the largest returns, both in quality and quantity of product, for the least cost per Btu. should be used.

Other factors, such as furnace design, preheating of air for combustion, the size of the charge, the working temperature, which latter is most important, all these influence the character of the coal which can be used and are important as regards fuel consumption.

In sheet mill practice it has been found that where continuous type furnaces have been used results have been much more gratifying than when the batch type furnace is employed. With the pulverized coal fired continuous annealing furnace results show that the fuel consumption is about one-half of that required in a hand fired type of like capacity; also the quality of the annealed products are improved and the floor space required is considerably less.

The continuous car type annealing furnace can be built in various sizes to accommodate 8, 10 or 12 cars and is of double chamber design, each chamber operating independently of the other. This arrangement is advisable so that in the event of one combustion chamber going out of service the other half is still operative. This furnace is usually underfired of the recuperative type and is adaptable to other fuels than pulverized coal, such as oil, natural gas, etc.

Charging is a continuous operation over a given time and is usually accomplished by a floor crane, a dead ended

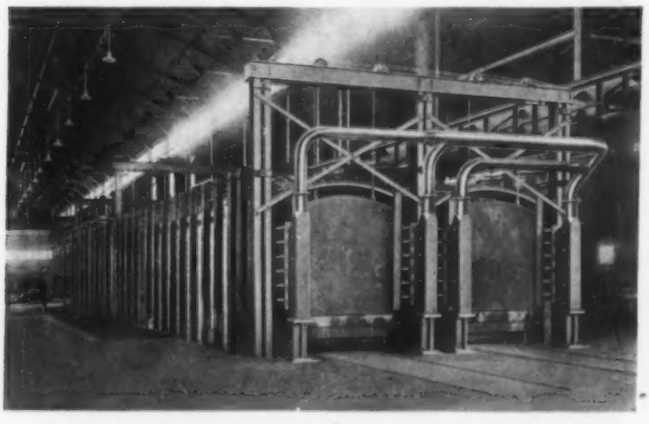

FIG. 2.

pulley and cables. Approximately the same charge is in the furnace at all times; for each car of finished material discharged, a car of raw material is put into the furnace.

Powdered coal for firing the furnace is injected into the combustion chambers through suitable burners. The burners are fed by screw feeders which take the supply from the storage bin placed contiguous to the furnace. The powdered coal is transported from the pulverizing plant to the furnace bins by means of a Fuller-Kinyon conveying system which combines the mechanical action of a short high speed screw with the fluidizing properties of medium-pressure compressed air to force the coal through a standard 5 in. pipe line to its destination. The bins are equipped with high level bin indicators electrically connected to signal lights which notify the operator when the bins are full. The whole system is operated by means of remote electrical and pneumatic

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control so that the mill man can supply all the fuel to the various bins without leaving his station in the preparation plant.

To get the best results when using pulverized coal as a fuel both in annealing, sheet and pair, and boiler furnaces, it is necessary to have properly designed furnaces so that the fuel can be fully consumed before leaving the combustion chamber. Sufficient combustion space should be provided so that the gas velocities will be low, thus permitting the gases to expand to a point at which the fine ash will be deposited by gravity in the furnace, thus preventing the carrying over and deposition of the ash on the material being treated.

Uniform conditions have been obtained in furnaces operating at 1400 to 1800 deg. F., the only objectionable feature being that some of the fine ash carried in suspension by the gas found its way into the mill through the furnace door openings and at times made it necessary to blow out the sheet furnace end at the beginning of a working turn. This small amount of labor, however, is virtually negligible compared to that required in hand fired furnace operation.

In a sheet mill making high grade sheets, the average coal consumption over a period of several months is about

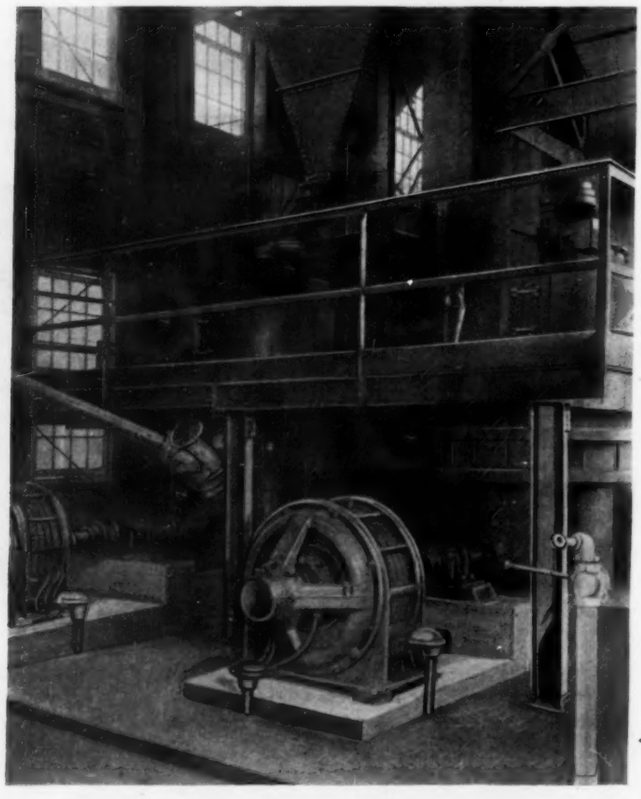

FIG. 3

200 lbs. of coal per ton of sheets. This will vary, however, with the quality of the product and for lower grade sheets the tonnage would be somewhat increased, thus decreasing the fuel consumption per ton of finished material. The quality of the product made and finished with pulverized coal firing is equal to the best. This has been conclusively demonstrated by tests. Operating conditions in several respects are greatly improved when pulverized coal is used. It is necessary to clean the combustion chamber only every week and this can be accomplished by two men in about two hours, presupposing, of course, that the slag chamber is of sufficient size to suit the capacity and type of furnace which it serves.

In the plant to which this article refers there are also two 444 hp. Union boilers fired exclusively with pulverized coal. The fuel used has a low fusing point ash and this is taken care of by providing a bed of sand in the bottom of the combustion chamber upon which the molten

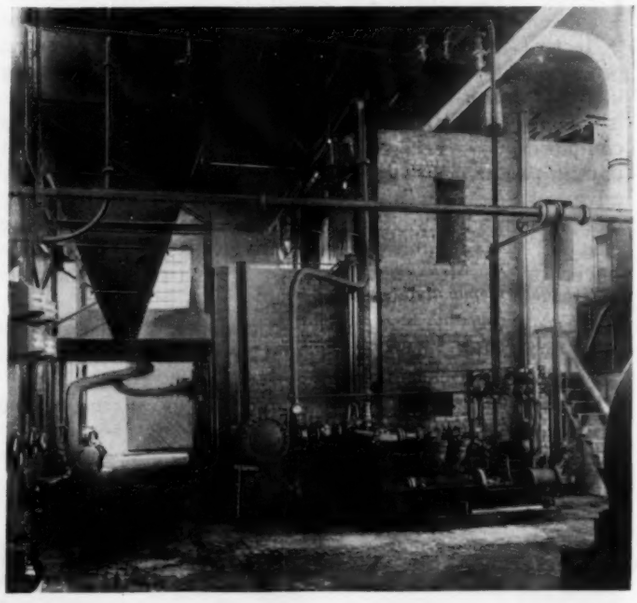

FIG. 4

slag is allowed to run. Two or three men working four hours are required to remove this slag bi-weekly. The powdered ash which accumulates in the flues is blown out by the steam at regular intervals.

Probably the most attractive feature in the operation of these boilers is the amount of labor required to maintain steam at the proper gauge pressure. One man fires two boilers and also serves as water tender and repair man. The coal is fed to the combustion chamber through a horizontal burner, primary air being provided by a fan which provides air at four ounce pressures, the amount of air going to the burners being controlled by slides or gates in the air blast pipe. Pulverized coal is fed to the burner by means of a screw feeder which is operated by a variable speed motor, hand controlled by the fireman, so that he has absolute control of the coal and air being fed to the boilers.

The November Issue

of

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*Discussion on Electrically Driven Reversing Mills**

E. S. Jefferies†: It has been my privilege to listen to the reading of this paper, and I would like to take this opportunity of congratulating the authors, Mr. Davis, Mr. Wright and Mr. Needham, because in this paper, we have, as far as I know, brought for the first time three competitors together who have met on an entirely mutual ground to discuss the absolute satisfaction in the operation of a certain electrical equipment.

Tonight, I represent the operating side of this question, and I think it is illustrated well by a remark I heard recently while having my shoes cleaned. The bootblack was working very hard, and I asked him, "Do you work pretty hard all the time?" and he said, "Yes sir, and I am here long hours, but there are lots of jobs that have to be attended to, and the only way to have them done right is to do them yourself." In part of the paper this afternoon, one of the authors referred to locking up sub-station over Saturday and Sunday. I do not quite agree with that, because, as the boot-black said to me, there are lots of jobs that have to be attended to, and to my mind, Saturday, or rather Sunday, is the time to prevent delays. It is the minor points to look into that every operator knows in the operation of such equipment as has been described to us this afternoon, that amount to the big points when it comes to the mill records, tonnage and delays.

After 10 or 11 years operating such equipment, there is only one question I would like to ask of the manufacturers, and that is, why don't they get a similar control? To illustrate my point of view, I would refer to a smaller motor, in size. No operating man is afraid to accelerate a d.c. motor with one point of control up to reasonable horse powers, and if, we will say up to 100 hp., a motor can be reasonably accelerated with only one point control, why should not larger motors be built to withstand the same strain and same conditions? To my mind, there is no reason because a motor is big, we should not treat it the same, if it has the same electrical conditions, as a smaller motor. That has been done, and I would like to hear the manufacturers' reasons, if there are any. why it should not be done with larger motors.

My opinion has been expressed many times before this Association as to what I think of reversing drive and shall not refer to it again tonight. I would like to see more facts published as to operating data, and have our friends, the steam men, come forward and dispute figures which I have presented before the Association. They were present at the time with a hope that they would be discussed from a steam point of view, but to date we haven't had that privilege from them. Saturday and Sunday work to me is a matter of personal contact with the men and the interest they have in the equipment. Mills of the electric type have operated for years, year in and year out, with no delays. Is there any other equipment that can operate under the same conditions with no delays—I mean absolutely no delays? I know of mills that have operated for seven consecutive years — a mill with no delay whatsoever. It is interesting from many points of view. The steam men have told me continually that it is impossible and they show records where mills are operated with many delays. I ask the question simply, where is the competitor of the electric motor?

Gordon Fox*: It was my understanding that we were coming over from Chicago to be educated and entertained so you must bear with me if I "think out loud" rather than to offer a prepared discussion.

The authors and the companies they represent are to be congratulated on the spirit of co-operation which prompted and accomplished this paper.

A certain widely advertised product uses the slogan, "Ask the man who owns one". It is proper that, in the discussion of electric drives, those who are responsible for maintaining operation of such equipment, be called upon. It is significant that the opinions expressed by those using electric drive are uniformly, I may even say unanimously favorable. This attitude is shared not only by the electrical engineers but by the managements as well.

One of the charts in the paper showed the relation of torque to speed of a reversing motor. So long as full field is maintained the torque per ampere input is constant. As the controller is advanced through this range the torque tends to increase and the excess is available for acceleration. If the controller is advanced beyond the point of full field the torque developed per ampere decreases and speed increase is obtained at the expense of torque. An operator who is not properly advised will naturally assume that, the farther the controller is advanced, the greater the torque available. It appears that this characteristic of reversing drives is not always fully appreciated.

The paper carried the story of the cost of electric power back of the motor, back of the flywheel set, back of the turbine generator to the boilers and the coal pile and stated the Btu. per ton per unit elongation. This was done advisedly in the endeavor to eliminate the many qualifications involved with any other basis of comparison with steam drives. It is the apparent intention to secure thereby a definite measure of the relative merit of steam and electric drive.

It is questionable whether even this procedure gives a fair basis of comparison. The extent of availability of surplus gas, coke braize or waste heat steam greatly affects the entire power plan. These waste fuels can be more readily utilized at one point than at another. Fixed charges play an important part. Relative operating costs and diversity factors on combined vs. segregated boiler plants. The availability of and cost of handling condensing water. These are a few of the factors which do not submit to any general method of measurement. So it seems to me that, although the Btu. per ton is a rational measure of power

*Presented before Pittsburgh Section, May 10, 1924. Discussion to be continued in future issues.

†Electrical Engineer, Steel Company of Canada, Hamilton, Ont., Canada.

*Electrical Engineer, Freyn, Brassert & Company, Chicago.

consumption, it cannot be used as a sole measure for comparison of steam and electric drive for a given plant.

I think a statement was made in the paper to the effect that the power consumption in kwh. per ton does not vary much with variation in tonnage produced by the mill. Under the ideal conditions which the author apparently had in mind, viz., the condition that the mill would be operated at its full capacity for a period and then shut down, that statement is quite true. But under the more frequent condition of low tonnage spread over the whole operating period, the statement is not true. The fixed consumption of the flywheel set, exciters and blowers is perhaps 10 per cent of full load. If the idling load occurs for a large portion of the time and rolling load requires but a small part of the time the consumption in kwh. per ton will be materially affected.

Barton R. Shover*: An objection could be made to a remark of the Chairman relative to publishing this data so that any time an operating official may wish to build a rolling mill, all that is necessary will be to reach up on a shelf and pull down the book. Now this idea, if it were practical, would tend to take the bread and butter out of the mouths of engineers, who hope to get paid for knowledge of that kind. Mr. Hunt, however, has come to our rescue by stating what all engineers know, that there is no panacea for all ills; that each and every case should be worked out on its own merits. There are in steel plants certain situations which are almost identical, and in those it is safe to copy, but there have probably been more mistakes made in the steel industry by copying what somebody else did than from any other single cause. Therefore, in picking out a drive for a mill, all conditions should be carefully studied and compared with conditions existing at other plants, using the rule suggested by Mr. Hunt. It would not be fair to compare estimates of steam costs on an old non-condensing engine with those of a modern electric system. Comparison should be fair, and unless all points are taken into consideration, the result will not be correct. Theoretical estimates are very frequently necessary, but after all, the comparison of actual results on the same basis is the final test. The results of motor drive are pretty well typified throughout the country. It has been my good fortune lately to prepare a paper on "Power in the Iron and Steel Industry of America", which paper will be presented at the World Power Conference in London in July next, and the Association of Iron and Steel Electrical Engineers kindly assisted in that work by sending out a questionaire. As is well known, the steel officials have been very much disgusted with questionnaires since the war mostly they are filed in the waste basket, or what is known as the "general file", but fortunately, 69 of the larger companies, representing approximately two-thirds of the total tonnage in the country, sent in replies. In that list there are nearly 100 more non-reversing rolling mills driven by motors than by steam engines, and while the number of engine driven reversing mills greatly exceeded those which are motor operated, it was found that during the last six years, out of a total of 21 reversing mills installed in the United States, 19 were driven by motors. This does not mean that the other two installations were wrong, for it is well within the possibilities that steam engine drive for those two places was the proper thing. One of the most interesting and valuable studies that could be made, would be a comparison of the results obtained from these two modern steam drives with two motor drives, provided the data for both were compiled by the same engineers using the same methods in both cases.

Another point in regard to comparison of electrical and steam drive is sometimes lost sight of. Mr. Hunt brought out the point that it was hardly fair to compare the steam consumption because of the difference in operators. That is true; one operator can use much more steam than another in rolling an ingot, but it is hardly possible that one operator can use many more kwh. than another for equal output, because of the automatic control on the motor. Most comparisons of the two methods of drive are based on test conditions. It is possible to have long steam lines for steam engine drives perfectly tight and thoroughly heat insulated, but such conditions seldom, if ever, exist very long after starting up a new installation. It is possible to keep the vacuum up to the estimated value at an isolated operating plant, but it is doubtful if it is done. It is not possible to keep an engine drive absolutely up to test conditions all the time, no matter how carefully gauges are watched and indicator cards taken. It is possible for an operator to pull the steam lever as many times in 8 hours as it is to throw the master controller, but the operator will undoubtedly prefer the master controller. On the other hand, with electric power, "leaks" in the line cause shut downs. Poor insulation on the motor means a shut down. If the motor gets too hot from any reason whatever, there is a shut down. In other words, as long as a motor is running, it is operating under test conditions, and the test efficiency can be met 365 days a year for the life of the equipment, be it 10, 15 or more years. Those are points which cannot be very well figured out on paper, but they exist just the same, and that is why tests should be made on and conclusions drawn from the results obtained by plants which have been in operation for at least one year.

Nineteen years ago the first motor drive for a rolling mill was installed in the United States at the Edgar Thomson Works of the Carnegie Steel Company. Those motors are still in operation, using the same main bearings that were installed 19 years ago, and absolutely the only repair was the substitution of high grade brushes. Can any steam equipment show like cost of maintenance? Another motor driven mill, installed over 6 years ago, has turned out more tonnage than any other mill of its kind in the country, and the total cost of material in repairs to date is 12c. That wouldn't pay for very many repairs on an engine. The electrical manufacturing companies claim that to date 47 engines driving roll trains have been replaced by motors, also that there is not a single instance where a motor has been replaced by a steam engine for this work. Officials who have sanctioned the installation of steam engines have expressed themselves as regretting such decisions, but no one seems to have ever heard of a similar regret in regard to the installation of a motor for mill drive.

F. G. Gasche*: Mr. Chairman, Members of A. I. & S. E. E. and Guests: As a guest of one of my associates in the Donner Steel Company and of the Association, I was assured that I would not be called

*Consulting Engineer, Pittsburgh, Pa.

*Consulting Engineer, Donner Steel Company, Inc., Buffalo, N. Y.

upon for discussion of the papers which have been presented on this occasion. With some complacency I resigned myself to the full enjoyment of the statement of the many excellent features of the reversing electric mill drive which have been ventilated, without attempted preparation of any discussion. I say this out of respect for the amount of labor which the preparation must have involved and particularly for the amount and kind of labor which has made the modern designs of reversing mill motors a possibility and in some applications commercially attractive.

Some years ago I had the great pleasure of cooperation and collaboration with your esteemed past president, Mr. B. R. Shover, in the installation of some very large mill motors, the first of their kind in the country. At that time, we, as pioneers, were compelled to consider many of the fundamentals, including units of measurement. Of course we found it necessary to prescribe the torque, energy and other requirements of the several mill passes applying to a given roll train and for the energy unit it was sufficient to state energy in foot pounds, or if you wish, in kilogram meters, but seldom, if ever in kwh. We certainly had no reference to mill performance in terms of "kwh. per ton". I would urge upon the engineers representing this organization the complete abondonment of the expression "kwh. per ton" because, in the language of the rustic who saw a giraff the first time: "There ain't no such animal." While not undertaking to fully substantiate my statements at this time, I wish to assure you that calculation of torque, energy, and power applying to a given pass or rolling operation is at present a fairly exact process though not commonly known. Errors of the order of 10 per cent of experimentally measured results for anything except the badly distorted sections are unnecessary. With this preliminary, I will assure you of the following:

First: There is no primary relation between the amount or number of "elongations" in a given pass and the energy requirement for the operation.

Second: The energy requirement of a group of mill passes having a certain aggregate number of "elongations" will not be the same for another group having the same aggregate of "elongations" if the abstract initial sections of the bars is different for the two groups.

Third: In view of the forgoing there can be no fixation of the ratio "kwh. per ton" for a given size or type of mill or even for the same product.

Owing to the limitation of comparative cost sheets the expression to which exception has been taken, may persist in certain operative accounts but the designing engineer having to contend with this class of mill drives will save himself the necessity of frequent and involved explanation if the so-called "unit of measurement" is abandoned.

R. H. Keil†: I regret very much that I was tied up this afternoon and did not have an opportunity to listen to this paper. I was very much impressed, however, by the remarks which Mr. Shover made, because I think he just about hit the nail on the head. So many comparisons on engine vs. motor drive figure cost at the engine only and do not carry it back to the coal pile and so are not of much value. I know by experience in our own plants, that the losses ahead of the engine are in many cases as great as in the unit itself. It is at this point, the electric drive shows a marked superiority.

Wm. Forsstrom‡: I have to agree with Mr. Fox that you are treating Chicago shabbily; I came here to learn something. We are thinking of putting in a new blooming mill and we are very much interested in the drive, and that is the reason I came up here. I hope to hear a little more from the steam end. I attended a meeting here before and the electric end was very well taken care of, but we had nothing from the steam engine men at that time. Mr. Hunt has added to that this evening, and I wish we could hear something from the Unaflow steam engine man, present tonight.

George E. Rose*: I am here as a guest also and hardly thought I would be called upon this evening, but I assure you I am very glad to be here and the meeting has been very interesting to me. If you fellows wouldn't accuse me of trying to get some expert advice, gratis, I might state our problem.

We have an old blooming mill driven by a twin, high pressure, non-condensing steam engine; from an economical standpoint, it is a "steam eater". We are contemplating the building of a new blooming mill and the question of how we should drive same is up for decision.

We have three blast furnaces and one boiler house at the blast furnace department, which is operated largely on blast furnace gas, but supplemented at times with a little coal when all three merchant bar mills are operating.

We have five 100-ton open hearth furnaces without waste heat boilers. It is our thought that if we installed waste heat boilers they would furnish sufficient steam for driving the new blooming mill either by a good, modern reversing engine or by means of turbine generators and an electric drive on the mill. In either case we believe we would fire very little, if any, coal at our blast furnace boiler house after taking the old blooming mill engine off this steam line.

We contemplate putting in a 40 in. blooming mill, capable of producing approximately 40,000 tons of 4 in. x 4 in. billets per month from an ingot weighing about 6,000 lbs. The engine installation would undoubtedly cost much less than turbine generators and the electric drive, yet if the above thoughts are correct as to probable coal that would be fired, the one would be just about as economical as the other to operate. Under these circumstances, what should we install, a steam or an electric drive? If this meeting wishes to get down to "brass tacks" on this question of electric vs. steam drive for reversing blooming mills, here is a concrete problem for discussion.

A. L. Foell†: I am indeed very glad to have been able to be here as a guest of the Association of Iron and Steel Electrical Engineers, and to have had the opportunity of enjoying the presentation of the splendid paper on this occasion.

The remark made a few moments ago suggesting that in order to answer the question of whether or not the installation of a reversing motor will, or will not show economies, is best accomplished by installing

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‡Chief Engineer, Wisconsin Steel Company, South Chicago, Ill.

*General Superintendent, Wisconsin Steel Works, South Chicago, Ill.

†Chief Engineer, Donner Steel Company, Buffalo, N. Y.

one, and producing the figures later. This would, of course, from the engineers' point of view, be a great relief to him. Unfortunately, for the purpose now, we do not have a reversing motor installed to drive our blooming mill at the Donner Steel Company, and for this reason I am not in a position to give any actual data concerning the operation of such equipment. It appears to me, however, that there is so much to be said about the electric reversing mill drive versus any other type of drive, that the deeply involved problem of determining which type of drive is most suitable and economical for any isolated plant requires serious study in each individual case. Every plant in this connection especially presents its own problem.

Ordinarily, when we speak of electric motors, we do not connect with them a reference to the source of energy supply, and we quite naturally overlook the fact that there is a boiler plant and power station with all its auxiliaries behind it, or perhaps some other type of prime mover furnishing energy in a form which must be converted into useable energy by the electric motor. Where the energy requirements in particular cases are small, it would seem entirely logical to consider an electric motor, as is generally done, the origin of mechanical energy.

When referring to an electric reversing drive, however, where a tremendous amount of energy is converted for use in one place, the power plant, or source of power behind the equipment should not so easily be lost sight of. In substance the reversing drive is a power transmission unit and should be so considered, for it is one method by which energy, possible of generation at a constant rate by a prime mover, operating at varying loads, but at constant speeds and in one direction of rotation, is converted according to energy demands into a form of useable energy at varying speeds, and both directions of rotation. Thus, making it possible to apply the steam turbine or other constant speed prime movers, where heretofore the reversing engine has been employed.

Generally speaking, the average steel plant, especially where blast furnace and coke oven operations are included, it is safe to say, has enough available waste heat and by-product fuel to enable the generation of sufficient power to satisfy its entire demand. Where this is possible, it is more prevalently accomplished through steam generating units, though in some cases gas engines are employed, utilizing the blast furnace gas. The matter of substituting an electric motor in place of the steam engine, it would seem, neither eliminates nor relieves the steam generation problem and does not eliminate the problem of converting to the fullest extent, the power available from waste heat and by-product fuels into useful energy by a steam prime mover. This is also true of where a choice between one or the other in a new installation must be made. However, the electric reversing motor will find many applications where due to local conditions, performance and in line with specific power generating schemes, its installation will be justified in that it makes possible economies in the entire power system not otherwise capable of accomplishment.

The reversing motor, as applied to a blooming mill, has many inherent advantages, making it superior to the ordinary drive. These are worthy of mention here for I believe they have not been touched upon yet. It lends itself to a positive control of the mill under all conditions, permits a uniform and constant flow of a tremendous amount of power at slow speeds with ease in manipulation and control on the part of the operator, all of which must unquestionably result in less destruction to the surface of the steel while in the rolls and resulting, therefore, in a better quality of product.

E. Friedlaender*: I have no practical experience with electric reversing mills, but have spent considerable time lately in blooming mills and wish to call attention to a few points I noticed comparing steam with electric drives.

You do not have to go very near some blooming mills to find out whether they have electric or steam drives, you can hear the terrific blow in the reversing gears miles away. Naturally this is very hard on the mill equipment. Electric drives are much better controlled and are noiseless and therefore much easier on the mechanical equipment.

Reversing mill engines were always made very heavy and mostly large enough so that some part of the mill equipment will let go before the engine breaks down. We all know from experience how serious breakdowns we had in our blooming mills from time to time.

Two men can operate the largest electric reversing mill and this may be cut down to one in the near future.

Steam drives require more attendants and spell hands on account of the greater physical effort necessary to operate levers.

Wherever motors have replaced steam engines, tonnage has been increased.

Standby-losses are greater on account of upkeep of steam, while mill is not rolling steel.

Normally there is very little upkeep on motors, they must be kept clean; engines require considerable more attention; there is hardly a more abused engine in the steel plant, than the reversing mill engine.

Power consumption data are taken from daily readings on reliable electric meters. Steam data is mostly compiled from tests under special favorable conditions by means of steam-flow meters, which are not accurate on fluctuating loads; such data does not represent the actual rolling conditions.

E. O. Knight†: We are in a very peculiar condition in having no motor driven mills. Our blooming mills, finishing mills and billet mills are all driven by steam. I suppose the proper procedure would be to start in with the blooming mill and put in electric drive, but instead of doing that we are going in the reverse direction and putting in a new mill on old drive. We wouldn't like to lose everything in that mill, because it makes so much noise that we would miss it at night. We are in hopes that we can replace some such installation as 46-60 high pressure steam engine with something like an electric drive that will get rid of that noise and run much more economically, and I have no doubt the time will come when we will have to go into those things, as we will be able shortly to get the electric current required from the turbine generator at the coke works. But all this is very interesting to me. I do not know that I could compare the results between electric and steam drive since Mr. Hunt has presented his paper, but shall be very pleased

*Superintendent, Electrical Department, Carnegie Steel Company,

†Mechanical Engineer, Carnegie Steel Company, Clairton, Pa.

to do so when we settle that question. It looks very much like electric drive at the present time.

F. A. Wiley‡: I have no discussion of particular interest to offer. There is one question, however, that I would like to ask. During the remarks of one of the speakers this afternoon the statement was made that there were no standby losses in the case of the motor driven blooming mill. I cannot quite agree with that statement, because where the current is purchased for the mill drive the demand charge must be considered a standby loss in case the mill is idle. The demand charge will amount to from 35 to 50 per cent of the total current cost, depending on the total kwh. consumption, and when the blooming mill is idle a certain portion of the demand charge is chargeable to it.

Frank McGough*: As one of those in a minor way connected with the first of the "two out of 21" installations of engine drives on blooming mills which have been made in late years, wish to accent what Mr. Hunt has said—that when our blooming mill was being installed in 1920, both our company and Mr. Hunt were favorable to the motor drive on this mill. It was only after several weeks' investigation of motor drive installations and after going into the matter thoroughly with the motor builders that it was decided that the motor drives then in operation did not meet the specifications for rolling which were necessary in connection with the future development of the Weirton operations and therefore an engine drive was installed.

In making any comparison of cost of operation of steam and electric driven equipment, care must be taken to start from the same fundamental basis. There is a fairly definite relation between the cost of steam and the cost of electric power—in a general analysis of a problem, steam costs from an inefficient boiler plant cannot be compared with electric power costs from an up-to-date power station nor can steam costs be compared with electric power costs when the power is generated by blast furnace gas engine driven generators. As Mr. Hunt has pointed out—each condition presents a different problem and must be analyzed independently.

In considering the purchase of electric power, there is also the factor of whether it will be possible to renew a favorable power contract at its expiration. Our company as had one experience at our Clarksburg plant where on an isolated pump drive it was found advisable upon the expiration of our power contract to install a motor generator set and supply the power from our plant because of the inability to secure another contract on same basis as the original.

The question of standby losses with an engine drive on a blooming mill is a serious one. However in any mill where steam is necessary for producers, pickling, heating, etc., it is impossible to eliminate all of these standby losses whether a motor or an engine be used for the blooming mill drive. In our particular case the type of drive would make but little difference in our standby losses, as the engine is close to the open hearth boiler house and the steam line supplying the blooming mill engine extends for practically a mile beyond the engine to supply process and heating steam to two of our other plants, these plants being entirely motor driven.

‡Electrical Engineer, Wisconsin Steel Works, South Chicago, Ill.

*Steam Engineer, Weirton Steel Company, Weirton, W. Va.

I would like to add as illustrating this point, a short analysis from our Weirton boiler operations for the first part of May, 1924. With the blooming mill not operating, the steam necessary for pumps, producers, picklers, etc., but not including steam for electric power or blowing engines, required the evaporation of about 150,000 pounds of water per hour in our steel works boiler houses. This would not be materially reduced if we were equipped with motor drive as no radical piping changes or uses of auxiliary steam could be made.

The additional steam required for the blooming mill engine and condenser air pump (taken from our boiler house operation), is from 450 lbs. to 575 lbs. per ton of ingots rolled, this range being great enough to allow for errors of determination, an average between the two being probably about right.

The charge made against an engine drive for steam is a matter of cost accounting and the practice may vary at different plants, however, the entire boiler cost must be distributed among the different departments and prime movers. Also in our case over the week-end shutdown any charge made for steam to electric power, blowing engines, miscellaneous use or standby, is to a great extent an accounting figure as very little coal is burned but entire load at the steel works is practically carried on steam generated by uses of blast furnace gas or waste heat from the open hearth.

In any mill there is always some operation where the tonnage produced by the plant is limited. By installing an engine drive on our blooming mill, Mr. Hunt has effected a combination of drive and mill which has repeatedly demonstrated that it could roll steel at a rate of 90,000 tons or more of ingots per month, and one which will in no way limit the future development of the Weirton operations.

W. C. Buske*: I have nothing to add to the discussion but there is one point I might mention. It has been stated here this evening that the life of a reversing mill is 25 years; if this is the case what would it cost to operate a reversing mill engine that has been in service from 10 to 25 years while the cost of coal today is so much, what will it cost in from 10 to 15 years.

The tests on the reversing mill engine are no doubt made under ideal conditions and after the cylinders, pistons and rings have been properly fitted, but I should imagine the power rate would be considerable more after the engine has been in hard service a number of years.

One gentleman mentioned the fact that they were mining their own coal at the plant, and by doing so the cost of same was considerable lower than buying from an outside source. This may be satisfactory at the present time but nevertheless there are ways and means to conserve the present supply and I believe we should employ every effort to do so, and for this reason I should imagine the electrical driven mills would be the most satisfactory to install.

C. H. Hunt†: Mr. Stoltz has questioned our steam costs. The costs used were higher than the costs at which we produce steam. Possibly, I have also made the cost of power higher than it should be figured. I think there is 1.13c in favor of the engine drive in our

*Master Mechanic, McConway Torley Company.

†Chief Engineer, Weirton Steel Company, Weirton, W. Va.

case, which we could still concede to the motor because we still have our difference of cost of investment in our favor. I could not help but notice the chart Mr. Stoltz has shown comparing the twin simple noncondensing engine with the turbo generator electric driven mill, whereby the water rate on the boilers was so high when the load was off, and it seems to me the boilers must not have been equipped with draft regulators for cutting down the rate of firing when there was no steam demand. I think that would also answer some of these questions on standby losses. If the standby losses were as great as indicated, a good portion of that loss would still be present when the electric driven mill was down, as over a period shut down the boiler plant could be slowed down or banked in one case as well as the other in case the boiler plant was used only to supply steam for the mill drive as is assumed in this case.

Several people have been remarking about hearing the mill a mile away when driven by engine. I used to live in Youngstown and resided about a mile from an engine. I have listened to my window sash rattling in response to the engine reversals many times but I question whether that was due to the engine but rather due to the excessive clearance of the old style wabbler spindle couplings and back lash of straight tooth cast pinions. One other thought I have to offer —I believe the motor and the engine each have their proper place, most certainly not the old simple noncondensing engine but a well designed compound condensing or Unaflow engine, and it is a subject on which anyone who is contemplating a new installation or change in existing drive, would welcome actual results and true and fair comparisons of both types of drives, this is what I hope will be the outcome of these discussions.

There is one thing that the officials of any company are interested in as much as these items of cost, that is that the mill should go along day in and day out and roll the tonnages they require. I know the motor does that and so far our engine has done it, often under maximum demand conditions. We have been able to meet the demands of the finishing mills for tons of steel at all times, and I think our people are satisfied with the engine. Our mill superintendent who has operated both engine driven reversing mills and motor driven mills claims his best records were made on engine driven mills. Just a few days ago, he made the statement that no matter what demand for tonnage was made upon his mill, he did not feel his drive was going to limit the tonnage produced.

Corrections September Issue

Fairbanks, Morse & Company, Inc., manufacturers of electric motors and generators, oil engines, pumps, water systems and light plants, occupied two booths, Nos. 110 and 117, at the exposition. Their exhibition was confined to electrical equipment, and there was on display as the principal item of interest a 25-hp. general purpose motor, 8-pole type, with the top part of the stator removed, leaving 4 poles connected and showing the entire internal construction. Their patented one-piece rotor winding for squirrel cage motors was also illustrated by three actual squirrel cage windings without core or mounting of any kind. This company is a pioneer in the use of ball bearings in electrical machinery, and their display featured this construction. Coming at a time when the Association of Iron and Steel Electrical Engineers is making an investigation of anti-friction bearings, this exhibition was particularly interesting. Mr. James H. Christie, Pittsburgh representative of Fairbanks, Morse & Co.; Mr. W. A. Black, chief engineer, and Mr. R. M. Coleman, manager of the New York electrical department, all attended the exposition.

Philadelphia Section

(Continued from page VII)

tegrating and Graphic Instruments as Applied to Industrial Plants." Horace B. Pratt, Meter Engineer, Metropolitan Edison Company, Reading, Pa.

Saturday, December 6—

"Essentials of Design of Electric Industrial Furnaces and Their Application to Building Up Load Curves," George P. Mills, Engineer, General Furnace Company, Philadelphia, Pa.

Saturday, January 3—

"The Relation Between Technical Papers and the Life and Work of Our Association," A. J. Standing, Superintendent, Electrical Department, Bethlehem Steel Company, Saucon Plant, Bethlehem, Pa.; A. C. Cummins, Superintendent, Electrical Department, Duquesne Plant, Carnegie Steel Company, Duquesne, Pa., and John F. Kelly, Business Manager, Association of Iron and Steel Electrical Engineers, Pittsburgh, Pa.

Saturday, February 7—

"Operating Results Obtained with the Use of Static Condensers," Wray Dudley, Electrical Superintendent, The American Rolling Mill Company, Ashland Division, Ashland, Ky.

Saturday, March 7—

"Foreign Steel Mill Practice." A committee report. Members of committee: Walter H. Burr, Chairman, Superintendent, Electrical Department, Lukens Steel Company, Coatesville, Pa.; F. B. Crosby, Electrical Engineer, Morgan Construction Company, Worcester, Mass.; F. L. Estep, Perin & Marshall, Consulting Engineers, New York, N. Y.; O. Needham, General Engineering Department, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.; B. R. Shover, Consulting Engineer, Pittsburgh, Pa.; L. A. Umansky, Engineer, Industrial Department, Steel Mill Section, General Electric Company, Schenectady, N. Y.

Saturday, April 4—

"General Ideas and Discussion." Every active member is invited to prepare a short paper on a subject pertaining to the application of electricity to the iron and steel industry.

Friday, May 8—

Bethlehem Meeting, Hotel Bethlehem, Bethlehem, Pa. Bethlehem Joint Meeting with the Lehigh Valley Engineers' Club, and the Lehigh Valley Section of the American Institute of Electrical Engineers. "The Application of Electricity to the Iron and Steel Industry," John C. Reed, Electrical Engineer, Bethlehem Steel Company, Steelton, Pa. Announcement of the results of the election of officers for the coming season.

Saturday, June 6—

Annual Outing. Details will be announced at the May meeting.

All meetings, unless otherwise noted, will be held in the Engineers' Club, 1317 Spruce Street, and will start promptly at 8 P. M. They will be preceded by an informal dinner at 6 P. M.

Attend every meeting and bring your friends.

*Discussion on Slagging Producer in Steel Works**

A. G. Witting†: I have been requested to discuss Mr. Huessner's paper on "The Slagging Producer in Steel Works". As it deals with a design hitherto practically unknown in this country which, besides, has been given very little attention in the literature, a discussion can only be theoretical—in other words, we have to be content with asking questions.

Mr. Huessner refers, however, several times to my discussion last year on Mr. Siebert's paper on "Economical use of Fuel in Steel Plant" and advocates the use of a slagging producer to supplement blast furnace gas, whenever its supply becomes deficient due to the tapping of a furnace, as against the fuel oil suggested by me. The figures used by Mr. Huessener in this connection stand in need of correction. If anybody takes the trouble of rereading my discussion, he will find that I was using the figures presented by Mr. Siebert—although some of them might be questioned—applying them to any eight-furnace plant. From these figures I made the deduction that during a number of short periods totaling four hours per day there would be a shortage at the rate of 29,550 cu. ft. per minute amounting to 7,092,000 cu. ft. per day of 100 Btu. gas (not 90 Btu.). If in a slugging producer one pound of coke generates 70 cu. ft. of 115 Btu., the substitute gas required would be 6,167,000 c. ft. produced from 39.3 gross tons of coke during four hours, making the daily proportional coke consumption 236 tons (not 37 tons).

But in this calculation I committed the error of assuming the gas consumption by the stoves and blowing engines proportional to the gas production, although it is obvious that the consumption goes on at an approximately uniform rate whether the furnaces are blown or casting. Correcting the gas distribution accordingly, the amount of gas at all times, available for power would be reduced to 193,221 cu. ft. per minute and consequently the occasional surplus (when all eight furnaces are operating) 45,901 cu. ft. per minute, making the deficit during four hours equal to 45,901 x 240 or 11,016,000 cu. ft. 100 Btu. gas. The substitute coke gas would, therefore, be 9,579,000 cu. ft. (at a rate of 39,962 cu. ft. per minute) produced from 61 gross tons of coke during four hours, making the proportional daily coke rate 366 tons. With a producer ordinarily operating at a rate of 200 tons per day, as advocated by Mr. Huessener, it would be necessary ever so often without previous notice to increase the normal operation 283 per cent, which means that the blast fan must be speeded up from 15,500 to 44,000 cu. ft. per minute.

To be sure, Mr. Huessener claims as one of the good features of the slagging producer its "extreme flexibility" of operation varying in rate from 50 to 600 tons for a 200-ton producer. But this is partly contradicted by the statement that "no matter how varying the load, the blast must always penetrate to the center". The remedy proposed of inserting special linings in the tuyeres cannot possibly be considered under the circumstances in question, when the change in rating must be practically instantaneous.

It seems to me that on this point alone the question of the feasibility of using a slagging producer as equalizer for blast furnace gas to generate power would be negated. But as I am only theorizing, I might exaggerate the difficulties. As the question of coke gas versus fuel oil is entirely an economcial one, it might, however, be asked if the cost of installation is not placed too low by Mr. Huessener. A 200-ton producer requires about half the amount of the coke needed by one of the blast furnaces; in addition, there are considerable quantities of ore, slag or scrap required to produce the iron which appears to be a necessary by-product of the producer. All of this material and product must be handled in an economical way, requiring an elaborate installation. Furthermore, its location is determined by these conditions, and it might offer great difficulties to construct such a producer with its accessories at an already existing blast furnace plant.

The handling of the gas introduces another problem, particularly if a waste heat boiler installation is necessary to obtain any benefit from the sensible heat in the gas, a condition declared by Mr. Huessener to be necessary to make the producer a paying proposition. But the high percentage of extremely fine dust will cause trouble in a waste heat boiler. This dust must, however, be removed before the gas can be utilized and the gas has to be cooled before it can be applied to any gas engines. It must consequently be washed and it would, therefore, appear necessary to forego the value of the sensible heat except that the coke gas, before it is added to the blast furnace gas in front of the gas washers, can be used to heat the gas leaving the washers with the object in view of making the gas perfectly dry by imparting to it a temperature above its dew point. The value of heat recovered would probably be small, but the saving resulting from clean gas mains, etc., might be sufficient compensation.

I have here presented a few of the questionable features of the use of the slagging producer as a more or less automatic regulator of the gas supply from blast furnaces. Summing them up I would say that the cost of installation would probably reach a considerably higher figure than the one given by Mr. Huessener, while the profit per fuel unit would be less, leaving the balance decidedly less favorable. This contention would hold even if my doubts as to the ability of the slagging producer to function as an equalizer to the extent and with the suddenness required would be groundless. But with regard to this feature I might add another question mark. If, as Mr. Huessener states, "iron production is a necessity", it might be argued that continuity of the operation of the slagging producer would be affected by the casting of the iron and that on this account the producer would not be at all times available and perfectly reliable—assumed, that it in every other respect would be able to fulfill the requirements as a substitute when-

*Discussion presented at the Nineteenth Annual Convention in connection with paper presented by K. Huessener.

†Assistant Chief Engineer, Illinois Steel Company, Gary, Ind.

ever one of the blast furnaces is off blast. After all, my contention may still hold good that the proper way to utilize the intermittent surplus of blast furnace gas is to burn it under boilers with oil as supplementary fuel.

It would perhaps be impertinent to criticise the figures presented as to the quality of the gas, as they presumably are obtained from actual operation. But some of the results reported seem to be too good to be true. Selecting, for instance, out of the range of analyses the most unfavorable, we get CO_2 equal 0.8 per cent and CO 32.6 per cent, in which case not less than 97.6 per cent of the carbon gasified has been oxidized to CO. In the very best ordinary gas producer practice it has not been possible to convert more than 85 per cent of the carbon to CO while 15 per cent remains as CO_2, which compound is the first product of oxidation in the blast zone. Now we are told that in this slagging producer has taken place a chemical reaction 97.5 per cent perfect or even better.

Even since I, about 12 years ago, first heard about slagging producers, I have thought that this type eventually would crowd out the present type of producers. Particularly did I think that the promised revolution of gas making by using oxygen instead of air only could be realized by means of a slagging producer. It is, therefore, disappointing to learn that the development so far has shown coal to be an unsatisfactory raw material. It is also surprising that, although the slagging producer has a relatively low blast pressure and deep fuel bed, nevertheless the gas should hold no high contents of dust. Until these defects are remedied the field of usefulness will be rather limited. Yet even so it should prove to be a decidedly useful addition to the steel plant auxiliaries. Even now it probably, as pointed out by Mr. Huessener, could advantageously be applied to heat the coke ovens permitting the use of all the coke oven gas for metallurgical purposes. It would not surprise me if the suggested mixing of this coke gas with coke oven gas for open hearths would prove successful. During our April meeting in the discussion of Mr. Chandler's paper on "Control of Pressure Gas Producers", I sketched the lines on which, at some time, gas producer plants would be designed; I mentioned the possibility of using coke instead of coal. For such an installation the slagging producer may be particularly well suitable. Even though the slagging producer would not be suitable as an equalizer for blast furnace work, it still will have a large field of service. It should be considered eventually as a step forward in the fight for the conservation of fuel and we are indeed greatly indebted to Mr. Huessener for having made us acquainted with the slagging producer.

Martin J. Conway*: Mr. Huessener is to be congratulated on his presentation of this interesting paper, as there has not been much published information on this type of gas generator. There has, however, been many attempts to develop a commercial slagging producer, each attended with more or less success as far as the quality of the resultant gas was concerned, but each having the same general operating difficulties as experienced by Ebelman.

In 1906, B. H. Thwaite, the gas power pioneer, in his efforts to produce a gas low in hydrogen in order that the clean cold gas could be compressed to a very high degree with air in gas engines without premature ignition, developed his so-called cupola producer. This producer was about 6 ft. in diameter and 30 ft. high.

It was found that coke of an even grading was the best fuel and the following gas analysis are recorded from the use of Lancashire bituminous coal and gas works coke containing 9.5 per cent ash.

	Gasworks Coke	Lancashire Bituminous Coal
CO_2	.8	2.0
O_2	.4	...
CO	30.4	29.0
H_2	.2	5.35
CH_4	4.1	2.05
N_2	64.1	61.6

In 1907 the French firm of Fichet & Heurty installed a battery of six of their "S. F. H. Producers" at Gironcourt, France, in connection with some plate furnaces and heating ovens.

The following gas analysis are recorded on various fuels:

	Brown Coal	Lignite	Coke Briquettes	Bituminous Coal
CO_2	1.4	2.5	1.6	1.0
CO	28.3	29.5	27.9	31.0
CH_4	7.5	3.2	2.0	6.5
H_2	7.7	6.7	1.2	6.0
N_2	55.1	58.1	67.3	55.0

In 1912 Carl D. Smith reports some preliminary tests in Technical Paper 20 on behalf of the Bureau of Mines. Continuous runs of from 75 to 100 hours were made on a test producer and in one test of 76 hours duration the average gas analysis was 31 per cent CO and less than 1.5 per cent CO_2.

Since 1912 until the present there has been at least six types of slag producers developed, each giving approximately the same results.

The experience of the operators of the slagging type of producers has been that this type of producer is capable of delivering a gas richer in CO than an ordinary producer gasifying similar fuel and at a greater rate per square foot of producer area.

However I believe it will serve a useful purpose to dwell a little longer on the disadvantages of the slagging producer, and the difficulties to be met with and overcome before this type of gas generator can be successfully adapted to steel plant practice, where the demand on almost any type of apparatus is of a fluctuating character.

In the slagging producer, as in any other type of producer, low ash content in the fuel is most desirable and more care must be exercised in the selecting of the fuel with reference to the temperature of the semi-plastic stage of the ash, its viscosity at the higher temperature ranges obtained in the fusion zone of the producer and the chemical composition of the ash.

Fuels high in ash content require large quantities of slagging medium which increases the quantity of refuse to be handled per ton of fuel gasified and the composition of the slagging medium will be dependent upon the chemical composition of the ash, a problem where a variety of coals are gasified.

Mr. Huessener's paper gives emphasis to the fact that for smooth operation of the slagging producer it is necessary to produce some pig iron and therefore desirable to carry this iron production to the farthest limit without limiting the flexibility of the producer.

*Fuel Engineer, Wheeling Steel Corporation, Steubenville Works.

The production of 20 tons of iron per day from a producer capable of gasifying 200 tons of fuel per day, which is well within the limits mentioned by Mr. Huessener, would introduce the factor of quality of the iron possibly at the expense of gas production, making the composition of the materials charged the chief point of interest rather than the quality of gas produced.

Another point that would affect the operation of the slagging producer making iron in moderate quantities would be the usual week-end shut-downs which take place in most steel plants, when the gas mains are cleaned of deposit and the gas valves cleaned and overhauled.

These shutdowns would seriously affect the melting and fluidity of the ash and the slagging medium and may produce a condition inside the producer that would affect the quality and quantity of the gas output for many hours.

A producer of this type should be well equipped with auxiliaries to clean the gas of dust as experience has proved to us that the gas generated in a slagging producer carries with it more dust than the gas obtained from an ordinary producer or blast furnace gas. Cases are on record where the dust has reached as high as 6 per cent of the fuel charged, the fuel in this instance being coke nuts from ⅛ in. to 2⅜ in. in size.

With reference to the chart shown in this paper, we would be pleased to have Mr. Huessener tell us on what scale of rating this chart was drawn and the period of time these fluctuations covered, also the thickness of the fuel bed above the tuyeres in Fig. 1.

Undoubtedly, the slagging producer is coming to stay, but its field at the present is very limited and it seems to us that the logical place to bring it to perfection is at some point where the gas demand is nearly constant and where recourse could be had to other fuel without seriously affecting the prime unit should the producer operation be interrupted.

Waldemar Dyrssen*: Mr. Huessner brings out some very interesting points in his paper, which should be studied carefully by the fuel engineers in our steel works.

The saving of fuel is one of the most important problems and the waste of blast furnace gas, due to the variation in production thereof and to the variation in demands of power and heat plays a very important role in regard to the fuel problem in steel works.

In trying to apply foreign practices to our conditions, we must, however, be careful as the requirements for our conditions might be quite different. I had occasion to visit a few German steel works this summer and I readily recognized that we have very much to learn from Germany, especially in regard to fuel saving, but, at the same time, I was made to realize the big difference in conditions and I think that a warning is justified regarding applying their practice too readily to our conditions.

In Germany the blast furnace gas is extensively used for heating furnaces, both alone or mixed with coke oven gas or producer gas or with both, for heating coke ovens, heating furnaces and open hearths, etc., and, of course, also for producing power in gas engines and part is often also burnt under boilers. It is evident that when the gas is used for so many purposes, which require the fuel in the form of gas, the slagging producer would be more attractive, but even in Germany I think that the management of the steel works will think twice before putting in a large slagging producer.

For our conditions, I do not think that the slagging producer is justified, as a rule, and in such cases where it might be justified, it should be considered as a last resource if other means of taking care of the peak requirements fail.

A slagging producer with a maximum capacity of 600 tons per day, together with waste heat boilers, is a very large piece of apparatus and when it is considered that only a fraction of the capacity will be utilized on the average, it is evident that the investment charges will be high. One must also take care of a large amount of slag and also of pig iron, which is not a desirable feature.

It is worth while to note also that the efficiency of the gasification in transferring calorific heat of the coke into calorific heat in the gas is low, about 70 per cent, and considerably lower than can be obtained in an ordinary gas producer when moisture is used with the blast, where the efficiency of gasification of coke is between 76 and 80 per cent.

The biggest drawback for the slagging producer is, however, the fuel, which is limited to coke of the same quality as is used by the blast furnaces. This coke is nearly always considerably higher in price than coal. The very cheap coke dust, which is quite a large by-product from the coke ovens, can, for instance, not be utilized in the slagging producer. If we can supply the peak requirements by using a fuel which costs less than good coke, we should, of course, do so.

I think that we can do so in every case where the fuel is not required in the form of blast furnace gas and I think that this is the case in the majority of American steel works. In our steel works a large amount of the blast furnace gas is always burnt under boilers for producing steam for power purposes. If we arranged these boilers so that, for instance, powdered coal can be instantly introduced when the blast furnace gas fails, I think that we could take care of the peaks in blast furnace gas production and also of the peaks in power requirements, and, at the same time, keep the pressure constant in the blast furnace gas mains, which furnish gas to those parts of the steel works requiring fuel in the form of blast furnace gas.

I also think that a lot could be done by varying the firing of blast furnace stoves so that they get more fuel at times when the maximum amount of blast furnace gas is available, which system has been proposed and tried in practice in Germany.

There are also many others uses for the peaks in blast furnace gas production which should be considered before the installation of a slagging producer is recommended.

*Metallurgist, U. S. Steel Corporation, New York Office.

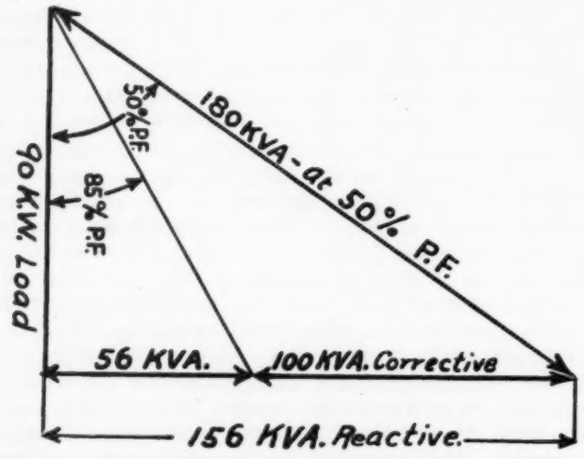
The November Issue
of
"IRON AND STEEL ENGINEER"
Will Contain
"Deevlopments in Electric Maintenance Shop Practice"

Power Factor Correction

By R. A. NEAL*

THE power factor of a plant may be improved to some extent by the rearrangement of motors so that they will operate more nearly at full load, but even after the motors have been correctly applied, production requirements vary, demanding motor sizes that result in poor load factors and consequently poor power factor conditions because the motors are not fully loaded at all times. The substitution of a few comparatively large synchronous motors in place of induction motors where conditions are suitable is frequently a satisfactory way of improving the power factor, but this is sometimes impractical, for the usual application is ordinarily best met by the simple squirrel cage induction motor. It is therefore the common practice to select the type of motor that is the most efficient for the particular application and to obtain the desired power factor for the plant by installing a few synchronous units or static condensers, which ever is best adapted to the particular conditions.

In general, the characteristics of each type of corrective equipment, static condensers and synchronous condensers, make it best suited to particular classes



of service. For each individual application one type or the other is preferable. The choice is usually one of relative economy, although in some cases service conditions are the determining factor, as, for example, where the requirements for mechanical drive indicate synchronous condensers definitely, or on the other hand, where provision must be made for expansion at a future time, in which case, static condensers are better suited.

In a particular application, the determination is best made by calculating the net return on the investment required for each type of equipment. This involves determining the first cost, the operating cost, and the gross return. These factors all vary—most of them over a wide range—in different installations. No general rule can be given, but from the standpoint of first cost and operating cost, the static condensers usually show up best in the small sizes and the synchronous condensers in the large sizes. The amount of investment required and the net return on that investment will give the basis for determining the type of equipment that is the most economical.

A typical case covering the application of a static or synchronous condenser would be about as follows:

Let us assume the service in the plant to be 2300 volts, three phase, 60 cycles, with a present load of 90 kw. at 50 per cent power factor. The desired power factor is 85 per cent, since the power company penalizes below this figure. The plant runs eight hours a day, 300 days a year, or 2400 hours a year. The overage cost of power is $.0175 a kilowatt hour.

Therefore, present kva. $= \frac{90}{.5} = 180$ kva.

Present reactive kva. $= \sqrt{180^2 - 90^2} = 156$ kva.

Kva. at desired P.F. $= \frac{90}{.85} = 106$ kva.

Reactive kva. at desired P.F. $= \sqrt{106^2 - 90^2} = 56$ kva.

Corrective effect needed $= 156 - 56 = 100$ kva.

Nearest size static for 3 phase $= 102$ kva.

From the solution shown in Fig. 1, it is evident that in order to raise the power factor from 50 per cent to 85 per cent it will be necessary to use either a 100 kva. synchronous condenser or a 102 kva. static condenser. The next step is to find out which is the most economical.

If a 100 kva. synchronous condenser is installed, it will be necessary to purchase the following equipment:

1	100 kva. synchronous condenser.....	$1420
1	Exciter	170
1	Set of auto-transformers for starting..	80
1	Manually operated, type QF starting panel	574
		$2244

The next thing to be determined after finding the first cost is what it is going to cost each year to maintain a power factor of 85 per cent. The losses in a 100 kva. synchronous condenser are 10 kw., and at a power cost of $.0175 per kw. hour and for 2400 hours a year, the yearly cost of these losses is $420.00. Assuming 15 per cent for fixed charges to cover interest, insurance, taxes, and depreciation, the fixed charges are $2,244 × .15 = $337.00. Hence, the total cost per year will be the sum of the power cost and the fixed charges, or $337 + $420 = $757.00, total cost per year.

Now to investigate the static condenser in the same way.

Cost of the static condenser..	$2,262.00
Fixed charges at 15 per cent..	339.30

The losses in the 100 kva. static condenser are 333 watts. The cost of operation for the static condenser for 2,400 hours at $.0175 per kwh. is $13.98. The total

*Manager Switch Section Supply Department, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

cost per year will be the sum of the power and the fixed charges, or

$13.98 + $339.30 = $353.28, total cost per year

The cost of operating the synchronous condenser compared to the cost of operating a static condenser is, therefore,

Total cost per year synchronous condenser	$757
Total cost per year static condenser.....	353
Balance in favor of static condenser.....	$404

Since the initial cost of the static condenser in this instance is but $18.00 in excess of the first cost of the synchronous condenser, the static condenser is the logical choice. In many cases even though the first cost of the static condenser is greater than the first cost of the synchronous condenser, the difference in the fixed charges soon offsets the difference.

In the above comparisons, there has not been taken into consideration the cost of a foundation which might be necessary with a synchronous machine, nor the maintenance cost. On each of these items the balance would be in favor of the static condenser because it requires no special foundation and requires no attendant.

The savings on the power bill should next be considered. Following is shown one of the many different methods of computing savings on power bills, which vary in different localities. Since there is a 90-kw. load for 2400 hours a year and the average power rate is $.0175 per kwh., the power bill will be:

$$90 \times 2400 \times = \$3{,}780$$

Since the power is billed at 85 per cent P.F. and the present power factor is 50 per cent, the amount that will be billed is:

$$\frac{85}{50} \times \$3{,}780 = \$6{,}426$$

Therefore the penalty is:

$$\$6{,}426 - \$3{,}780 = \$2{,}646$$

Since the penalty is the amount saved by correcting the power factor, in this case it is very desirable to correct the power factor because it costs but $353 per year to save $2,646. On this particular installation the static condenser will practically pay for itself the first year.

In case there is a bonus for correcting the power factor above 85 per cent and it is corrected to unity, the power bill will then be:

$$\frac{85}{100} \times \$3{,}780 = \$3{,}213$$

which shows a bonus of

$$\$3{,}780 - \$3{,}213 = \$567 \text{ bonus}$$

This bonus brings the total savings up to

$$\$2{,}646 + \$575 = \$3{,}221$$

In this case the first cost would be

1-156 kva. condenser = $3,078

and the cost per year would be:

Power cost (500 watts) 2400 hrs. at $.0175	$21.00
Fixed charges at 15 per cent.....	461.70
	$482.70

If the correction were to unity, the static condenser would almost pay for itself the first year.

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*Discussion on Fuel Savings Conference**

W. C. Buhl, Jr.: The author is taking this opportunity to submit a closure since several points appear in the printed discussion which were not directly covered in the original remarks from the floor made by these gentlemen. On page 13, Mr. Siebert makes a number of remarks on leakage, bearing particularly on the subject of distortion within the recuperator structure from the heat of secondary combustion.

The refractory of which Chapman-Stein recuperator tile are constructed is of the highest grade of acid brick made by the Harbison-Walker Refractories Company, whose best brick are recognized in the steel industry as, if not the best, among the three or four brands worthy of this title. This brick when used in furnace combustion chambers is frequently called upon to stand temperatures approximating 3,000 deg. F. and does this without failure, even in periodic furnaces. Since the recuperator with tile made from the same material receives the fumeé after passing from the furnace proper and is at the same time being continually cooled by the air passing through it, it would seem that the wildest imagination could not conceive of these tile even approaching the furnace temperature and consequently the thought of failure of the brick by fusion is so remote that it need hardly be considered. At least it has never yet occurred in 15 years of operation. I can only reiterate what I have previously said regarding leakage; that in furnaces built in this country that have been shut down and cold at least 100 times in two and one-half years, we

ENCLOSED POT FURNACE

GENERAL DATA

	Recuperative Furnace	Regenerative Furnace
Fuel consumption (natural gas)	110,000 cu. ft.	180,000 cu. ft.
Fumeé to recuperator or regenerator	2,330 deg. F.	2,500 deg. F.
Fumeé from recuperator or regenerator	780 deg. F.	1,250 deg. F.
Air from recuperator or regenerator	1,930 deg. F.	1,450 deg. F.
Analysis, Fumeé CO_2	11.7	10.0
O_2	1.1	4.6
CO	0.0	0.0
Excess air	5 per cent	25 per cent
Glass per day	16,000 lbs.	12,300 lbs.
Heat in batch per lb. (assumed)	600 Btu.	600 Btu.
Flame temperature fuel, cold air (theoretical)	3,200 deg. F.	3,200 deg. F.
Flame temperature fuel, hot air (theoretical)	4,100 deg. F.	3,600 deg. F.
Percent increase calorific value	38 per cent	27 per cent
Percent increase flame temp.	22 per cent	12 per cent
Gas cu. ft. per ton glass	13,750 cu. ft.	29,260 cu. ft.
Fuel saved per 24 hours	70,000 cu. ft. or 38.8 per cent	
Increase in glass per 24 hours	3,700 lbs. or 30.0 per cent	
Decrease fuel per ton of glass	15,510 cu. ft. or 53 per cent	

*Discussion in connection with W. C. Buhl, Jr.'s, paper presented at Fuel Savings Conference, April 3, 1924, and appearing in the June issue Iron and Steel Engineer.

have been unable to find evidence of leakage or change within the recuperator structure. The fact that we have these various records given us by steel plant operating officials would indicate that the Chapman-Stein recuperator makes unnecessary the consideration of leakage, as it has been shown that it will remain free from leakage for an indefinite period of time. In view of the amount of time given in this discussion to the subject of leakage, it would appear that leakage is inherent in all other designs and types of recuperator, but, as we claim, absent in the Chapman-Stein.

On the same page, Mr. de Fries uses Mr. Siebert's remarks on secondary combustion to emphasize the necessity for proper burner design. I agree with him partially in this, but believe that, as by far the greater number of large heating operations are carried on with raw producer gas fuel, the aspirating type of burner would find a very limited application except in the few fixed fuel installations. I do, however, claim that the use of aspirating burners requiring a large power factor for the compression of the fuel or air is unnecessary and that with proper air and fuel port design and co-ordination, the use of power for compression is an unnecessary and needless expense. In the usual continuous furnace which has considerable length, it is entirely possible and our usual practice to burn all the fuel that may be burned within a given volume without reaching an excessive temperature and the consequent failure of the furnace refractories.

The Chapman-Stein recuperator shows a sub-atmospheric pressure within the air flues. This sub-atmospheric pressure is from velocity head obtained by the stack action of the vertical air ducts. This dynamic pressure, exerting its force at the collecting chamber at the top of the recuperator proper, is converted to static head. The air pressure from the top of the recuperator to the mixing ports is always materially above atmospheric pressure and consequently an aspirating device is not required to assure that air in excess of the quantity required is always available, under velocities such as to insure rapid and proper mixing.

Mr. Dyrssen, as well as Mr. Siebert, has asked for exact figures, and I include in this article data and a balance sheet of an enclosed pot furnace as used in the glass industry. It is believed that these figures require no further comment as they are self-explanatory.

ENCLOSED POT FURNACE—HEAT BALANCE

One Day's Operation

Figures are Btu.

	Recuperative Furnace	Regenerative Furnace
Heat Input—		
In fuel	121,990,000—71.5%	199,620,000—73.5%
In air	48,620,000—28.5%	72,000,000—26.5%
Total heat	170,610,000—100%	271,620,000—100%
Heat Distribution—		
Radiation and unaccounted for in furnace	88,850,000—51.8%	116,640,000—43%
To downtakes	72,160,000—42.6%	147,600,000—54%
Efficiency—		
To batch	9,600,000— 5.6%	7,380,000— 3%
Total heat	170,610,000—100%	271,620,000—100%
Recuperator or Regenerator Performance		
Heat Input—		
To recuperator or regenerator	72,160,000—100%	147,600,000—100%
Heat Distribution—		
Radiation in chamber	2,860,000— 4.3%	3,600,000— 2%
In fumeé at stack	20,680,000—28.7%	72,000,000—49%
Efficiency—		
To air	48,620,000—67.0%	72,000,000—49%
	72,160,000—100%	147,600,000—100%

Arrange to be present at the meeting to be held at Reading, Pa., Under the Auspices of the Philadelphia Section

Subject: "Measurement of Power as Applied to Industrial Plants" by H. B. Pratt, Engineer Metropolitan Edison Co., Reading, Pa.

New and Improved Products

COPPER bars that can be bent double with one finger, but which require strength to straighten again, are expected to lead to a greater understanding of the properties of metals. The bars, which are really single crystals of pure copper, were produced in the Research Laboratory of the General Electric Company at Schenectady, N. Y., and have been subjected to many kinds of examinations, with the revelation of numerous unexpected facts.

Knowledge about the properties of metals had been limited in the past to observations of masses of small crystals. The usual piece of metal is a conglomeration of small, closely packed crystals, with the crystalline structure usually apparent at a glance. Zinc, for instance, is known as a brittle metal; a rod of it can be bent but slightly without snapping. Yet investigations of small, single zinc crystals show that any one crystal of the metal can be drawn out to six times its length in one direction; in another direction it is extremely brittle. The properties of zinc thus depend upon how the crystal is examined—whether "with the grain" or against it. The usual piece of zinc is really a collection of small crystals pointing in all directions, so that the properties are the combined qualities of the small crystals in the different axial directions. The same holds true for other metals and other substances.

A single crystal of copper seven-eighths of an inch in diameter and six inches long, as well as numerous smaller crystals of the same metal, have been produced by Dr. Wheeler P. Davey of the Research Laboratory. These crystals, obtained by a modification of the method devised by Dr. P. W. Bridgman of Harvard University, are much larger than any previously recorded.

Very gradual heating and cooling of pure copper in an electric furnace is the secret of the success in producing them. The necessary amount of pure copper, in the form of a bar, was placed in a closed, cylindrical carbon crucible, and slowly passed through the electric furnace. If molten metal is cooled quickly, the resultant mass is composed of very small crystals; if the melt is cooled slowly, the crystals are larger. Dr. Davey cooled the melt so slowly that only one crystal was produced, and that included the entire melt. The atoms had plenty of time in which to arrange themselves as they desired—to build up a single crystal rather than a multitude of small ones.

Several interesting results have been obtained with the large crystals. A piece of about the size of a lead pencil, if given a jerking motion, bends as easily as does a stick of soft wax; it cannot be bent back, however, any more easily than a similar piece of ordinary copper. When the copper is a single crystal, all of the atoms are arranged in columns, equally spaced. When the bar is bent, the spacing is changed; the atoms on the inside curve are pressed together, and those on the outside are spread apart. Strains are set up and the crystal structure is altered. The bar becomes an ordinary piece of copper, of smaller crystals facing in all directions.

If the surface of the large crystal is nicked or dented, the structure in the neighborhood is changed in the same way. It is similarly affected by filing or polishing. When one of the bars is polished it is necessary to take off a mil or less at a time. Even then the structure of the new surface is altered. The condition is remedied by etching away the surface with the usual acid bath.

An etched bar of the copper appears to be rough. There seem to be alternate dark and light lines. The appearance of the lines is due to the fact that the acid etches more easily in some directions than in others. The directions in which it etches with the greatest difficulty are parallel to the axes of the crystal.

Externally the large, single copper crystals differ little from the usual metal. X-ray analysis, however, furnishes conclusive evidence that such a crystal has been produced. Dr. Davey, by means of special apparatus, was able to prove that he had one crystal. In the usual examination a small tube of finely powdered crystalline material is placed in the path of a narrow beam of X-rays of a specified wave length. The substance turns the X-rays in different directions, according to the arrangement of the atoms in the minute crystals. A series of lines is produced on a photographic film, and these lines are used in calculations which reveal how the atoms are arranged and how far apart they are. Copper crystallizes in the face-centered cubic system, i. e., the atoms are arranged at the corners of an imaginary cube, with another atom in the center of each face. In studying the single crystal Dr. Davey revised the method of examination so that the large crystal was used, rather than crystalline powder. The specimen was swung slowly back and forth through an angle of 30 deg., with the edge in the path of the X-rays. The rotation of the single crystal produced the same effect as using a stationary powdered sample, and a pattern was received on a stationary film. At the same time a moving film was used, mounted on the turntable with the crystal. If the specimen had not been a single crystal, no lines would have been obtained on the movable film, since the X-rays would have affected the entire film uniformly. The lines were obtained, however, and calculations based on a comparison of the two negatives showed that the axis of the crystal was parallel with the direction of cooling the ingot.

It is difficult to foretell the results which will follow a study of large metal crystals. It has been thought for several years that such specimens would have unexpected properties, and now the prophecy is substantiated.

Current Transformers for Super-Accuracy on High Secondary Burdens

Current transformers designed for accurate metering where the secondary burden is high have recently been placed upon the market by the Sangamo Electric Company, Springfield, Illinois.

These transformers are known as Types F and G. Both types are rated at 50 volt-amperes and are built in capacities from 5 to 1000 amperes. The Type F is intended for use on circuits not exceeding 7,500 volts, 25 to 133 cycles, while Type C is intended for use on circuits not exceeding 15,000 volts, 25 to 133 cycles.

Both types are also built with two separate secondary circuits, one for meters and the other for relays and other auxiliary appliances.

Automatic High Voltage Compensator

An automatic high voltage compensator has just been placed on the market by the Electric Controller & Manufacturing Company, of Cleveland, Ohio.

This compensator is built for voltages 2,500 and below. It is push button operated and entirely automatic. With the exception of the overload panel, which is mounted on the top of the tank, the compensator is entirely submerged in oil and the tank is so designed that the compensator is dust-proof, weather-proof, vapor-proof and fire-proof. It can be installed either indoors or outdoors.

A push button is operated by an independent low voltage circuit which is taken from an independent transformer so that there is no danger of the operator ever coming into contact with the high voltage circuit.

Having the starting transformers and the operating mechanism entirely submerged in oil and automatically operated removes all possibility of explosions or high voltage flashes.

This automatic compensator is so designed that continuous torque is applied to the motor from the time the push button is pressed until the motor has been brought up to speed.

Operating the start switch causes the motor to be started under reduced voltage obtained from the transformers in the compensator and after the motor has reached the proper and safe speed it is automatically thrown across the line by the compensator.

It is believed that a great many more high voltage motors will be used now that a safe high voltage starting compensator has been placed on the market.

Automatic Reclosing Circuit Breaker with Provisions for Manual Operation

Automatic reclosing circuit breakers have long since emerged from the class of new devices. In certain fields, notably in coal mines and electric railways, they have an established place as one of the devices essential to efficient operation. In other fields and in industrial plants generally, where interruptions due to overloads and short-circuits are not so frequent, automatic reclosing circuit breakers have not been so generally adopted. The reason for this probably has been that the advantage of the automatic reclosing feature has not been sufficiently apparent to offset the thought that an automatic reclosing circuit breaker is more complicated than a manually operated circuit breaker. There has also no doubt been considerable hesitancy in the past in applying automatic reclosing circuit breakers to important feeders in mills and industrial plants because of some doubt as to what should be done in the event that the circuit breaker failed to operate. While failure to operate may be regarded as an unusual occurrence, it is folly to deny that the possibility of such failure always exists with automatic control.

In order to overcome these objections and obstacles to the more extended use of automatic reclosing circuit breakers, the Automatic Reclosing Circuit Breaker Company of Columbus, Ohio, has recently developed a circuit breaker which normally is full-automatic in its operation but it may at any time be operated in the same manner as a manually operated circuit breaker, to which industrial plants and mills are accustomed.

When operating as an automatic reclosing circuit breaker, it is under the control of a double pole push button switch. When this switch is in the "off" position, all of the control circuits of the breaker are completely disconnected and the breaker remains open. When the switch is in the "on" position, the control circuits of the breaker are connected and the breaker closes provided conditions on the line are proper for it to close. On overload, it opens automatically, remains open a short time interval regardless of load conditions, and at the expiration of that time interval, recloses providing the overload or short circuit which caused it to open has been removed.

When for any reason whatever it is desired to operate the circuit breaker manually, the control switch is thrown in the "off" position and the operating handle attached to the breaker. The breaker is then closed in the usual manner by depressing the operating handle. It will open on overload or voltage failure if provided with no-voltage release. The operating handle is removed when the breaker is again placed in automatic operation.

This most recent development represents the most complete type of circuit breaker protection that can be had. The refinements of automatic control are had, coupled with assurance of high grade circuit breaker protection at all times and under all conditions. At the present time, breakers of this type are available in capacities up to and including 2,000 amperes.

New Voltage Tester

The Square D Company has issued a little folder covering a new voltage tester.

For a long time electricians have realized that a pigtail socket and an ordinary lamp had a lot of shortcomings when it came to indicating voltage. In the first place, lamps were easily broken and consequently were expensive over a period.

This voltage tester requires no lamps, and consequently there isn't anything about it which is easily broken. It is enclosed in fiber which withstands rough usage.

For a complete description of the voltage tester secure catalog No. 5000.

The Mutual Electric & Machine Company has issued a very attractive pamphlet which illustrates and describes the added advantages of "Bull Dog" safety switches in the new "Luminized" finish—an aluminum deposit process.

The November Issue

of

"IRON AND STEEL ENGINEER"

Will Contain

"Developments in Electric Maintenance Shop Practice"

A complete discussion by the engineers of the steel industry. You cannot afford to miss this copy. Look for it.

Six-Ton Electric Furnace

A six-ton horizontal ring type induction steel melting furnace, the largest of its kind in this country, has recently been placed in successful operation by the General Electric Company at the plant of the Allegheny Steel Company, Brackenridge, Pa. This unit operates on the principle of a transformer, the secondary circuit of which is the metallic bath or furnace charge.

The furnace is rated 800 kw. at 2,200 volts single-phase, 8.5 cycles, with a hearth capacity of 12,000 pounds. Suitable refractory lining material is provided in the form of "Furnite", a composition of calcined and electrically fused magnesia developed by General Electric. The furnace has four doors, one of which is used exclusively in pouring and the other three for charging and inspection of the hearth. Conventional motor-driven tilting mechanism of the rocker type is provided.

Power is supplied at 25,000 volts, 60 cycles, 3-phase. This is first stepped down to 2,200 volts and is then converted into 2,200-volt, 8.5 cycle, single-phase power by means of a motor-generator. A motor-driven blower supplies cooling air to the furnace winding.

The average time necessary for melting, refining and alloying a charge of 7,000 pounds of steel scrap is four hours, with a total overall energy consumption of about 800 kwh. per ton. The furnace is operated by one melter and two helpers in 8-hour shifts, the operation being continuous.

One of the desirable features claimed for this unit is a high grade product of extreme uniformity, resulting from the ease of metallurgical control and the cleansing and stirring action caused by the electro-magnetic forces in the metal bath.

Inductive Time-Limit Controller

When electric motors were first installed in the steel mill, the main requisite of the controlling equipment was to provide protection for motors. Experience in the use and application of motors, developments in motor and controller design, gradually changed operating methods. It was found that the power of the motor could be applied more effectively and the controller assumed an entirely different role. It is now designed and used to make the motor perform specific duties regularly, necessary to meet the requirements and operating schedules of the mill in general, and, in addition, protect the motor.

To insure getting the greatest production of the main mill, all machines of an auxiliary type, but which are nevertheless a part of the complete production equipment, must be constantly performing their pre-determined work according to a definite time schedule or cycle to dovetail into the production program. There is a definite time limit for each operation or job.

Operators work efficiently if they can count on the same time periods for various operations, they synchronize their movements accordingly and carry out their duties almost automatically.

Steel mill engineers have favored the "time-limit" control, and recognizing this, Cutler-Hammer engineers, long experienced in the design and application of steel mill motor control, have developed a controller which incorporates a new principle of time-limit control which has none of the features that have been found unsatisfactory in the past.

Dashpots and other mechanical and electro-mechanical means have been tried but while suitable in many kinds of service, they have not satisfactorily withstood the strenuous steel mill duty.

Simplicity Attained.

In the design of this time-limit starter the inductive principle is utilized to obtain the accelerating time, a transformer being used in place of relays, inter-locks, dashpots or other moving parts to control the time of acceleration. The entire construction and all parts are extremely simple—there are no moving parts other than the reversing switches, main magnetic switches and the accelerating switches.

Through the medium of the transformer a holding out current of transient nature is obtained in successive accelerating switches.

Transfer of connections takes place automatically with the cutting out of successive steps of resistance without disconnection of the coil circuits.

In this new development, the acceleration period is very uniform under ordinary conditions of load variations, the time being somewhat increased on heavy loads. Thus the machine driven, whether reversing table, screw-down or other auxiliary machine, is always brought up to speed in the same period to insure the productive synchronism and plant efficiency desired.

The adjustments for the timing of the acceleration are made on the stationary parts and are, therefore, permanent. Adjustments to meet all requirements can be made.

Particular attention has been given to the ease of replacement of wearing parts, permanency of adjustment, reliability of operation, elimination of ruptured coil circuits and burn-outs and slow deterioration of arc-rupturing contacts. Arcing tips are provided and the arc shields of the blowout provide a deep channel in which the arc is disrupted. The main contacts are of the butt type.

Two types of these starters are made, one suitable for reversing table service and one for applications where the motor is liable to stall as on screw-downs and side guard manipulators. For this latter service a jamming relay is added.

The switches used consist of the main contactor, reversing switches and the accelerating switches.

The master switch is small and compact with snugly fitted cover. Standard mill type non-stubbing fingers are used interchangeable with other C-H drum controller fingers. The contacts are self-oiled, the oiling wick holding enough oil for six months' operation. The cylinder is mounted on a square shaft conforming with the construction of all Cutler-Hammer drum controllers.

STATEMENT OF OWNERSHIP, MANAGEMENT, ETC., OF
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Business Manager—John F. Kelly, 706 Empire Bldg., Pittsburgh, Pa.

Names and addresses of stockholders holding 1 per cent or more of total amount of stock: None.

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Known bondholders, mortgagees, and other security holders, holding 1 per cent or more of total amount of bonds, mortgages or other securities: None.

JOHN F. KELLY, Editor and Business Mgr.

Sworn to and subscribed before me this 26th day of September, 1924.

JOHN G. HOSICK, Notary Public.

(My commission expires March 7, 1925.)

ALPHABETICAL LIST OF INVENTIONS FOR WHICH PATENTS WERE ISSUED ON THE SEVENTH DAY OF OCTOBER, 1924*

Bearing protector	W. D. Snider	1,510,806	Oct. 7
Bearing, roller	W. B. Bronander	1,510,920	"
Cable clamp	C. A. Butler	1,510,920	"
Carbon black, production of	G. C. Lewis	1,510,485	"
Coal burning apparatus, pulverized	P. C. Mulligan, F. S. Brinton, H. W. Schmitz	1,510,693	"
Die rolling mill for the manufacture of roll forgings	W. B. Cowles	re 15,923	"
Electric brake	F. W. Borkes	1,511,022	"
Electric conductors	R. Rudenberg	1,510,558	"
Electric fixtures	J. Cuthbert	1,511,206	"
Electric heaters	C. E. Patterson	1,510,796	"
Electric-wire cleat	J. Levandofsky	1,510,789	"
Electrical circuit transmitter	J. M. Diegel	1,510,587	"
Electrical measurement	H. P. Hollnagel	1,510,780	"
Electrical power transmission by radiation	A. J. Kloneck	1,510,624	"
Electric protective device	P. MacGahan	re 15,929	"
Electrically-driven device	J. J. Reeder, H. G. Hosely	1,511,138	"
Electrodes	C. L. Burdick	1,510,541	"
Electrode accumulator	E. Vare	1,510,617	"
Engine cooler	A. P. Clark	1,510,766	"
Engine valve mechanism	C. R. Short	1,511,203	"
Engine valve mechanism, supercharging internal combustion	E. R. Burtnett	1,510,651	"
Engines, accelerator for combustion	W. S. Schuyler	1,510,708	"
Engines, carburetor for internal combustion	P. Morelini, V. Duprat, H. Eisenschmidt	1,511,134	"
Engines, cooling systems for internal combustion	F. E. Aseltine	1,511,204	"
Engines, fuel feed for internal combustion	G. M. Bicknell	1,510,453	"
Engines, muffler for internal combustion	L. J. Martel	1,510,791	"
Engines, reversed gear for constant pressure int. combustion	P. A. Lawrence	1,511,208	"
Engines, radiator for internal combustion	W. C. Chapin, J. H. Pettee	1,510,828	"
Engines, telltale attachment for explosions	J. H. Mount	1,510,601	"
Fuel, regulating combustion of	F. H. Brown	1,510,758	"
Furnace	V. Tanier	1,510,510	"
Furnace casing, sectional	G. Harms, R. C. Walker	1,510,673	"
Gas mixtures, apparatus for liquifying and separating	R. Mews	1,510,703	"
Gear cutter	F. Hodgkinson	1,511,077	"
Gear wheel, resilient	O. Kjelsberg	1,510,943	"
Gears, manufacture of and apparatus therefor	D. C. Hooker	1,510,889	"
Gearing, toothed	F. Ljungstrom	1,510,895	"
Internal combustion engine	A. T. Brown	1,511,023	"
Internal combustion engine	E. R. Burnett	1,510,650	"
Internal combustion engine	P. Hentschke	1,510,620	"
Internal combustion engine	W. E. Jory	1,510,677	"
Internal combustion engine	C. F. Kettering	1,511,201	"
Internal combustion engine, two stroke	R. Deacon	1,511,112	"
Iron alloy, cast	H. Shiokawa	1,511,142	"
Jet conveyor construction	L. Ellman	1,510,928	"
Lathe, center drive axle	W. E. Ward	1.510,811	"
Lathe, drill and like machine	G. W. English	1,510,771	"
Lighting fixture	M. Berkowitz	des 65,723	"
Lighting fixture	M. M. Marks	1,510,489	"
Lighting fixture, emergency	O. W. Althoff, L. S. Baluta	1,511,097	"
Lightning arrestor	P. T. Williams	1,510,731	"
Locomotive, electric	E. D. Priest	1,511,064	"
Metals, uniting	J. B. Austin	1,511,194	"
Milling machines	G. D. Sundstrand	1,510,566	"
Milling machine knee	G. D. Sundstrand	1,510,565	"
Nail making machine	A. H. Brigham	1,510,827	"
Oil burner	B. C. Berg	1,510,916	"
Oil burner	E. C. Wills	1,510,639	"
Pipe coupling	N. M. Frazier	1,510,838	"
Pipe coupling	W. H. Fulton	1,510,548	"
Pipe cutter	M. Schang	1,510,611	"
Piston	R. R. Hart	1,510,778	"
Piston for fluid pressure engines	F. T. Burgess	1,510,760	"
Power plant	A. LaFon	1,510,688	"
Pulverized fuel burner	L. H. Bergman	1,510,645	"
Pulverized fuel burning furnace	H. Kreisinger	1,510,994	"
Pulverizer	J. F. Weeks	1,510,638	"
Pulverizing and mill therefor	D. V. Sherban	re 15,930	"
Pump	H. M. Crippen	1,510,830	"
Pump, air-lift and air-driven rotary	H. H. Henderson	1,510,990	"
Pump, control lever with connections, fuel	A. A. Asplund	1,510,576	"

Pump, fluid pressure	L. S. Doten	1,510,884	Oct. 7
Pump, rotary	F. A. Gillespie, C. Meyer, H. B. Meade	1,510,744	"
Pumps, controlling apparatus for air pressure systems	A. F. Habenicht	1,511,034	"
Regenerative furnace	A. N. Diehl, S. G. Worton	1,510,588	"
Sand blasting apparatus	G. W. Cristoph	1,511,025	"
Sheet handling mechanism	H. M. Barber	1,510,914	"
Steam injector, exhaust	R. D. and J. C. Metcalfe	1,510,999	"
Tube machine	J. F. Gail	1,510,932	"
Valve, check	M. Smolensky	1,510,967	"
Valve grinder	J. Crowe	1,510,831	"
Valve metering	P. L. Scott	1,510,802	"
Valve mixing	C. G. Holt	1,510,991	"
Valve registering	C. S. Munro	1,510,856	"
Valve, safety	J. C. Sullivan	1,511,143	"
Valve spring compressor	W. C. Burrows	1,510,542	"
Valves, device for operating	A. A. Asplund	1,510,577	"
Wire working apparatus	J. Prutscher	1,510,525	"

*Printed copies of patents are furnished by the Patent Office at 10 cents each. Order by patent number. Address Commissioner of Patents, Washington, D. C.

The Ten Commandments of Salesmanship

By DR. FRANK CRANE

Some time ago I wrote an article on "Salesmanship from a Consumer's Standpoint." I have received so many requests from business houses to republish this that I have decided to rewrite it, make it more concise, and cast it in the form of Ten Commandments.

It is to be kept in mind that these commandments are supposed to come from the consumer, and not from the sales expert. If you want to sell me or any other buyer of goods, therefore, we pray you to keep these commandments:

1. Be agreeable. Other things being equal, I go to the store where the clerks try to please me. I buy clothing, typewriters and automobiles of the man who acts as though he likes me. Exert yourself to make a pleasing impression on me, please. I appreciate it. Hence, dress well. Untidy clothes mean you don't care what I think of your appearance. But don't dress too well. That gives you an air of showing off. Dress just right. If you don't know how, find out. Cut out all mannerisms. Give me the impression of a gentleman, honest, square, anxious to please, and good natured.

2. Know your goods. Don't let there be any question I can ask you relative to the manufacture, history, distribution, or uses of what you have to sell that you cannot answer. If you are selling typewriters, know all about the kinds. If you're selling coffee, find out all about where all sorts of coffee come from, and all points about them. Put in your spare time making of yourself an encyclopedia of information about your goods.

3. Don't argue. Go with me in your talk, not against me. Lead, don't oppose. Don't show me where I am wrong. Don't dodge a square issue, and show me wherein you are right. Suggest. Don't antagonize. Argument as a rule results in irritation, not conviction.

4. Make things plain. Don't use any words I don't understand. You can explain the most complicated matter to a washwoman if you know your subject perfectly and practice using simple language. Don't air your technical knowledge and try to impress me. I wan't to be flattered, not awed.

5. Tell the truth. Don't lie, or exaggerate, or mislead, or conceal. Let me feel that you are sincere, and mean every word you say, and that every statement you make is of par value. If you represent goods that need lying about, directly or indirectly, quit. There are plenty of articles that are straight and all right. Sell them.

6. Be dependable. Even in small things create the impression that whatever you promise is as much to be depended upon as your signed note. If you make an appointment at 3 P.M. Tuesday, be there at 2:45, or telegraph. If I order goods of a certain grade, let them be found to be exactly of that grade when I receive them.

7. Remember names and faces. If you have not a natural gift for this, acquire it. Get a little book and set down every day the names of those you have met with their characteristics. Practice this until you become expert. No man likes to be forgotten or to have you ask his name.

8. Don't be egotistic. Eliminate the pronoun I as much as possible from your vocabulary. Talk about me, not yourself. Don't tickle yourself, tickle me. I'm the one you want to win.

9. Think success. Success begins in the mind. Why think fifty cents, when it is just as easy to think fifty dollars? Tell success stories, not incidents of failures and hard luck. Radiate prosperity. Feel prosperous. It's catching. Keep your chin up.

10. Be human. The reason you are hired to sell goods is that you are a human being. Otherwise your employer would have sent a catalog. So be a human being, likable, engaging, full of human electricity. For I patronize as a rule the salesman I like.

Selling goods is the greatest business in the world. It takes all there is in a man. You need to know psychology, you need tact, intelligence, self-control, courage, persistence and inexhaustible good humor. It is not a job for a second rater. You simply have to make good or go under.

I admire a good salesman because I never was able to sell anything in my life. But I'm a good buyer.

Reading Meeting

Auspices

PHILADELPHIA SECTION
A. I. & S. E. E.

Saturday November 8th, 1924

BERKSHIRE HOTEL
READING, PA.

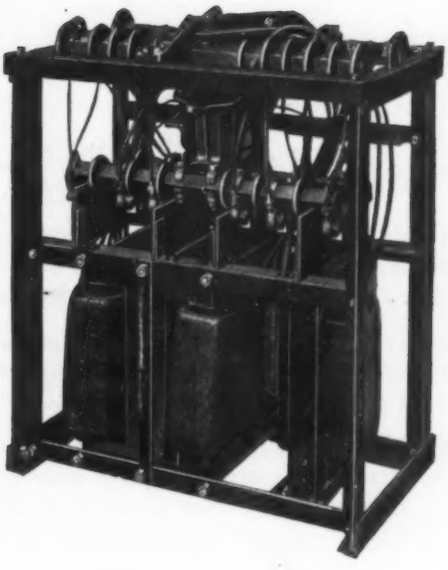
Measurements of Power as Applied to Industrial Plants

By HORACE B. PRATT
Engineer, Metropolitan Edison Company
Reading, Pa.

The Engineers of the Iron and Steel Industry are all invited to attend the meeting to be held in Reading. This will be one of the largest gatherings of the year.

Make your Hotel Reservations early.

NEW
EC&M
HIGH-VOLTAGE COMPENSATOR



For starting squirrel cage motors on 2500 volt or lower voltage circuits.

It is push-button operated and automatic. It protects against overloads and single phasing.

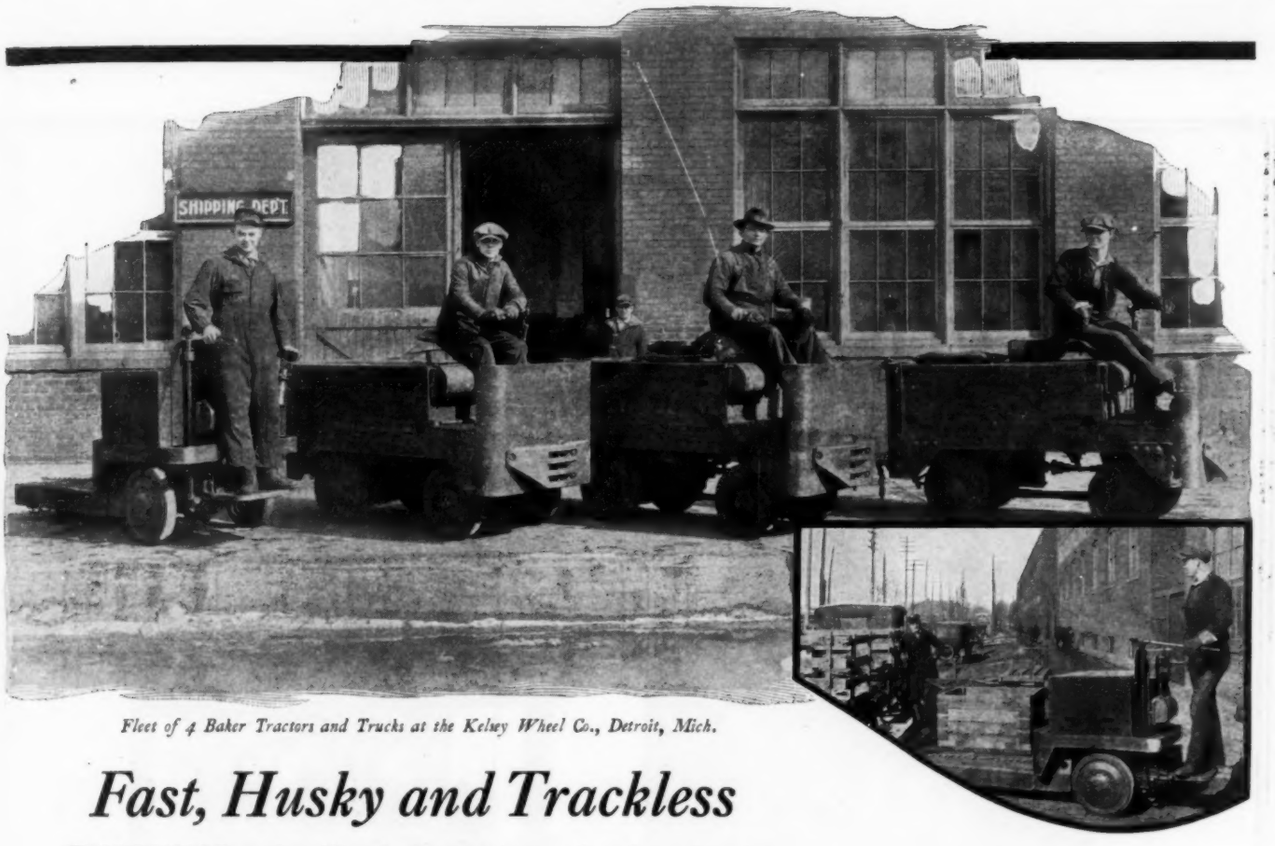
Push one button to start and push another to stop. The motor is accelerated with continuous torque.

It is oil-immersed, dust-proof, weather-proof, vapor-proof and fire-proof. Install it indoors or out.

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

BIRMINGHAM - BROWN-MARX BLDG.
CHICAGO - CONWAY BLDG.
CINCINNATI - 1ST NATIONAL BANK BLDG.
DENVER - 3535 WALNUT ST.
DETROIT - DIME BANK BLDG.
LOS ANGELES - THOMAS MACHINERY CO. AMERICAN BANK BLDG.
NEW YORK - 50 CHURCH ST.
PHILADELPHIA - WITHERSPOON BLDG.
PITTSBURGH - OLIVER BLDG.
SAN FRANCISCO - CALL BUILDING
SEATTLE - 524 1ST AVE. SOUTH
TORONTO - TRADERS BANK BLDG.



Fleet of 4 Baker Tractors and Trucks at the Kelsey Wheel Co., Detroit, Mich.

Fast, Husky and Trackless

SHOVING and pulling bulky loads on a hand truck may be an impressive display of what muscle can do. But it's bitterly expensive, measured by modern standards.

Business today finds it more economical and more practical to put hand tractors on more productive work and to utilize power in solving its haulage problem.

A single industrial tractor or truck is often sufficient for all material handling—prodding lazy materials into action and cutting costs to the lowest possible point. In other cases, different types of machines are more adaptable for various kinds of work.

There is a Baker tractor or truck for every material handling problem. Write for our complete catalog, or ask to have a Baker engineer first study your conditions and then recommend the most efficient type for your needs.

Baker Industrial Division
THE BAKER R & L COMPANY · · · CLEVELAND, OHIO

The Pride of the Fleet

THE KELSEY WHEEL CO. uses tractors to pull heavily loaded trailers about the shop or in the street under all kinds of weather conditions.

But for versatility and all-around usefulness the shop foreman swears by the Elevating Truck above.

It carries 3 tons down crowded shop aisles at 6 miles per hour, turns corners that look impossible and negotiates a 15% ramp without difficulty.

A truck like that, that never tires on the busiest day and is always on the job when you need it, saves enough in six months to cover the invoice for the equipment.

THE BAKER R & L COMPANY
Cleveland, Ohio

ELECTRIC TRACTORS AND TRUCKS

TRADE-MARK REG. U.S. PAT. OFF.

Baker

A BRUSH OF PROVED QUALITY

Use

N C C

259

On

DC side of Rotary Converters

DC Generators

DC Motors

AC Commutator Type adjustable speed motors where commutators are undercut

and secure minimum commutator wear, cool operation with splendid commutation and consequent increased efficiency.

National Pyramid Brushes

Manufactured and guaranteed by

NATIONAL CARBON CO., INC., Cleveland, Ohio—San Francisco, Cal.

Canadian National Carbon Co., Limited, Toronto, Ontario

Emergency Service Plants

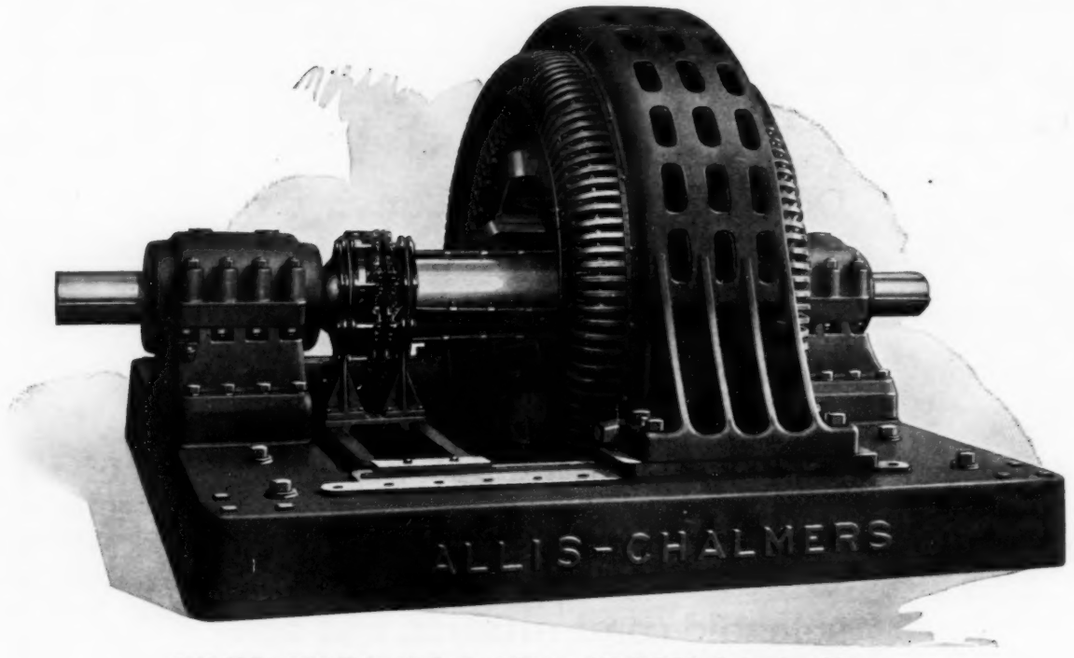
CHICAGO, ILL.
551 West Monroe St.
Phone: STAte 6092

PITTSBURGH, PA.
7th Floor, Arrott Power Bldg. No. 3, Barker Place
Phone: SMIthfield 0740

NEW YORK, N. Y.
237 East 41st St.
Phone: VANderbilt 0425

ALLIS-CHALMERS

Rolling Mill Motors



3000 H.P., 6600 Volt, 25 Cycle, 3 Phase, 147 R.P.M., Induction Motor
built for United States Steel Corporation

Complete Electrical Equipment

For All Types of Main Roll Drives

Heavy Duty Power and Electrical Machinery

ALLIS-CHALMERS PRODUCTS
Electrical Machinery
Steam Turbines
Steam Engines
Gas and Oil Engines
Hydraulic Turbines
Crushing and Cement Machinery
Mining Machinery

ALLIS-CHALMERS MANUFACTURING COMPANY

MILWAUKEE, WISCONSIN. U.S.A.

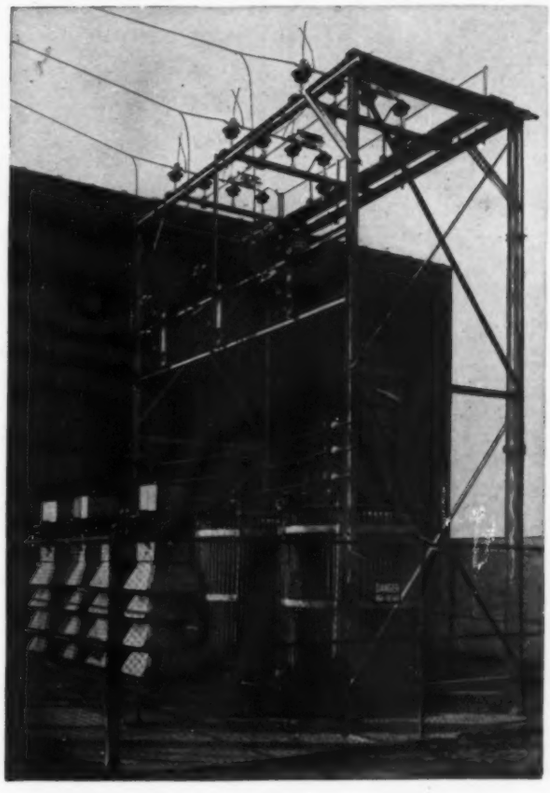
ALLIS-CHALMERS PRODUCTS
Flour and Saw Mill Machinery
Power Transmission Machinery
Pumping Engine-Centrifugal Pumps
Steam and Electric Hoists
Air Compressors - Air Brakes
Agricultural Machinery
Condensers

THE STANDARD OF COMPARISON

The Delta Star

UNIT TYPE

For Any Capacity



Unit Type Stations

For Any Voltage

Prompt Shipment

UNIT-TYPE outdoor substations are designed by engineers who know operating requirements, engineers who have the ability and experience necessary to combine utility and appearance. Just submit your outdoor substation requirements to Delta-Star. We know you will like our service.

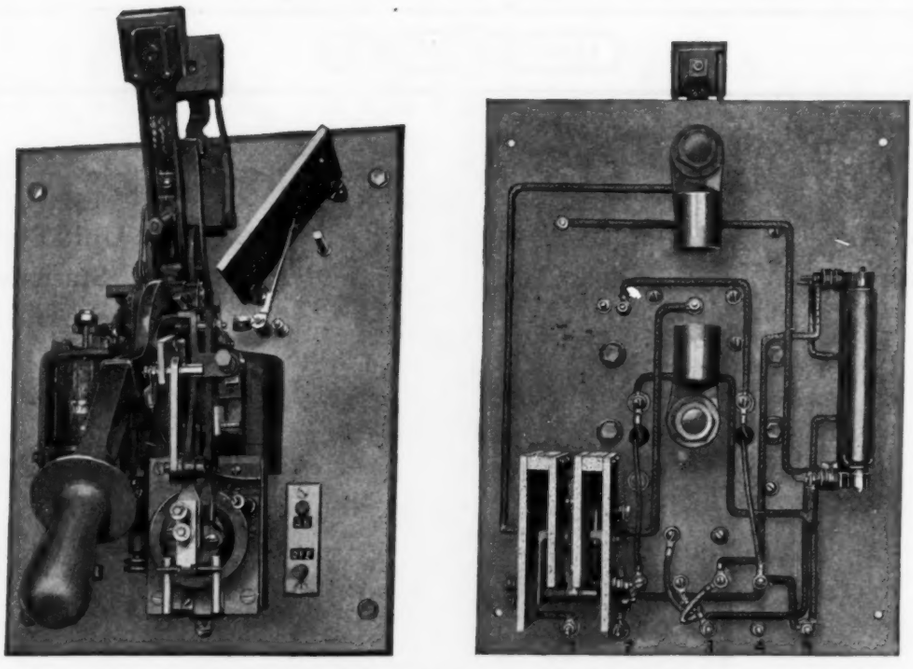
DELTA-STAR ELECTRIC CO.

2400 Block Fulton St Chicago, Illinois

Birmingham, Ala., 827-830 Brown-Marx Bldg.
Boston, Mass., 294 Washington St.
Buffalo, N. Y., 595 Ellicott Square
Charleston, W. Va., The Eng'g Service Co.
Columbus, Ohio, 600 Joyce Realty Bldg.
Detroit, Mich., 708 Ford Bldg.
Indianapolis, 518 Trac. Term. Bldg.
Kansas City, Mo., 301-2 Dwight Bldg.
Knoxville, Tenn., Holston Nat'l Bank Bldg.
Los Angeles, Calif., I. W. Hellman Bldg.
Minneapolis, Minn., 940 Security Bldg.
New York, N. Y., 25 Broad St.
Orlando, Fla., Cornell-Mathews Co.
Philadelphia, Pa., 1333 Real Estate Trust
Pittsburgh, Pa., 934 Union Trust Bldg.
Rochester, N. Y., 119 Main St., E.
Salt Lake, Utah, 313 Dooly Bldg.
San Francisco, Calif., 193 Second St.
Seattle, Wash., Hoge Bldg.
St. Louis, Mo., Railway Exchange
Syracuse, N. Y., City Bank Bldg.

UNIT TYPE CEMENTED SWITCH INSULATORS

A Manually Operated Circuit Breaker
That Recloses Automatically



Front and Rear Views, Type "AHM" 600-Ampere Automatic Reclosing Circuit Breaker
With Removable Handle for Manual Operation

or

An Automatic Reclosing Circuit Breaker
That May Be Operated Manually

either way

This Circuit Breaker Embodies All That Is to Be Had in a Circuit Breaker
and Assures You High Grade Circuit Breaker Protection
At All Times and Under All Conditions

With That Refinement in Service That Can Be Had Only With

The Circuit Breaker with Brains

Bulletin 314-F Gives Details.

THE AUTOMATIC RECLOSING CIRCUIT BREAKER CO.

COLUMBUS, OHIO

PITTSBURGH: 1815 Oliver Bldg.
ST. LOUIS: 401 National Bank of Commerce Bldg.
WILKES-BARRE, PA.: 816 Miners Bank Bldg.
CHARLESTON, W. VA.: 314 Moore Building

INDUSTRIES using electrical energy save 80% annually in fuse maintenance costs by installing Economy Renewable Fuses in the place of "one-time" fuses.

The famous Economy "Drop Out" Renewal Link—the least expensive and the only portion of the fuse destroyed in operation—makes this saving possible.

Check up your fuse costs.

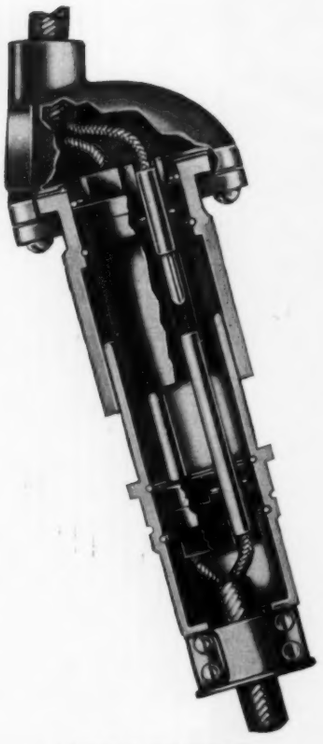
For Sale by All Leading Electrical Jobbers and Dealers

ECONOMY FUSE & MFG. COMPANY
Chicago, U. S. A.

Economy Fuses were the first line using an inexpensive bare renewal link for restoring a blown fuse to its original efficency to be Approved in All Capacities by the Underwriters' Laboratories.

ECONOMY *renewable* FUSES

ARKTITE CIRCUIT BREAKING PLUGS AND RECEPTACLES



ARKTITE RECEPTACLE
With Plain Housing Mounted on Type QEE Condulet—Plug Partially Inserted—Sectional View.

Embody New Principles in Plug and Receptacle Construction

—Circuit broken in separate chambers.

—Contact parts enclosed in separate chambers of insulating material.

—Arc instantly smothered.

—Current carrying parts fully protected.

—Means provided for effectively grounding portable devices.

Made in 2, 3, and 4 Poles, for 10, 30, 60, 100, and 200 Amperes and for 250 Volts, A. C. or D. C.; or 600 Volts, A. C.

LISTED AND DESCRIBED IN BULLETIN NUMBER 2055

CROUSE-HINDS COMPANY
SYRACUSE, N. Y., U. S. A.

SALES OFFICES
NEW YORK
BOSTON
CHICAGO
PHILADELPHIA
DETROIT
ST. LOUIS
MINNEAPOLIS
CINCINNATI
SAN FRANCISCO

CH 125

CROUSE-HINDS

PYLE O LYTE

The brighter Flood Light

Increases Production-Cuts Down Overhead

PYLE-O-LYTE

You'll find a wide range of types and sizes for every flood-lighting requirement.

Cases built of long-lived cast aluminum alloy that will outwear ordinary sheet metal units—Storm, Gas, Rust, Proof.

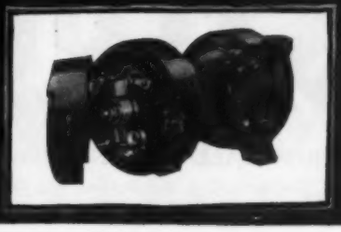
Write for Catalogue No. 4.

STEAM TURBO-GENERATORS

Pyle National Steam Turbo-Generators are made in five types—Capacities ranging from 500 watts to 7½ K. W. Steam Consumption less than that of any other turbo-generator of equal size and capacity.

The PYLE-NATIONAL COMPANY

General Offices and Works:
1334-58 N. Kostner Ave.
CHICAGO



In Canada:
The Holden Co., Ltd.
Montreal, Winnipeg,
Vanccuver, Toronto

Double-acting thrust bearing, flat seats (grooved races) 2100-F Series

Single-acting thrust bearing, flat seats (grooved races) 1100-F Series

Single-acting, self-aligning thrust bearing 1100 Series

Single-acting, self-aligning thrust bearing, leveling washer. 1100-U Series

Double-acting, self-aligning thrust bearing, leveling washers 2100-U Series

All Ball Bearings Look Pretty Much Alike—*But*—

THE PRESIDENT KNOWS that if his corporation is to be a dividend-payer it must produce a quality product. So he tells his engineers to get the best bearings, because no part of the mechanism is more important.

THE PRODUCTION MANAGER KNOWS that ball bearings play a most important part in the efficiency, economy and long life of his product. So he demands the best.

THE CHIEF ENGINEER KNOWS that Strom Ball Bearings have emerged successfully from the severest tests to which bearings have ever been submitted. He knows that they give rotating units the rigidity they require for smooth operation. He knows that they are hardened throughout, not merely case-hardened. He knows that the dimensions are held to close tolerances. He knows that for long life and hard service Strom Ball Bearings have an unexcelled record. So he recommends Strom Ball Bearings.

THE PURCHASING AGENT KNOWS what it means to tie up with a manufacturer with facilities, production capacity, high quality product and a record for promptness. So he selects Strom Ball Bearings, because back of them is a factory and a service he can depend on.

THE SALES MANAGER KNOWS that he has a powerful sales argument when he can say that his product is equipped with Strom Ball Bearings throughout. The superiority of Strom is a recognized factor in the automotive field.

THE CUSTOMER KNOWS that faithful and efficient performance of your product is insured because it is equipped with Strom Ball Bearings which have proved their superiority over a long period of years.

Whatever your bearing needs may be Strom Ball Bearings will give satisfaction. Our engineers are at your service. They will gladly work with you, or for you, to aid in any way. Write for information.

Strom BALL BEARINGS

STROM BALL BEARING MFG. CO.

Formerly U. S. Ball Bearing Mfg. Co.

4594 Palmer Street, Chicago, Ill.

Single-row deep-groove Standard type, radial bearing

Double-row, deep-groove Standard type, radial bearing

Angular contact bearing, combination radial and thrust

Double-row, maximum type, radial bearing

Single-row, maximum type, radial bearing

Are your departmental power costs *rising?*

How much electric energy per unit of output did your foundry use? Your machine shop? Your pattern shop?

How will your accounting department allocate power charges correctly against each of these departments?

Do you know where power is being wasted? How can the loss be located?

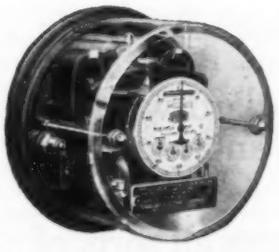
All these money-saving, cost-finding factors are essential to the economical operation of the modern industrial plant.

But you cannot get this data unless you install suitable watthour meters on each main electric light and power feeder serving each department or manufacturing process.

Large savings have been made by many industrial concerns through the use of Sangamo Watthour Meters for this important service.

Write for data.

SANGAMO



Sangamo Type D-5 Watthour Meter for Switchboard Mounting.

Sangamo Electric Company

Springfield, Illinois

New York Chicago Birmingham San Francisco Los Angeles

SANGAMO METERS

FOR EVERY ELECTRICAL NEED

6920-4

Dust-Tight Heavy Duty Unit

For Steel Mills and Foundries

A Dust Tight Glass Cover Sealed to 14″ R.L.M. Type RR Reflector by a Rugged Gasketed Cast Holder

Catalog No. 29950 For Cover Only

Hinged to permit easy change of lamps.

Made heavy and tight to keep out Dusts, Vapors and Smoke.

Cuts down labor for maintenance and keeps illumination up to original high values.

This device is an indication of the extent to which Benjamin is developing from time to time special protective equipment designed to maintain illumination at original standard without excessive expense for labor in cleaning reflectors and replacing broken lamps.

The Benjamin line of lighting equipment includes all sorts of heavy duty reflectors and fixtures designed to meet both usual and unusual lighting requirements in shops, mills and foundries.

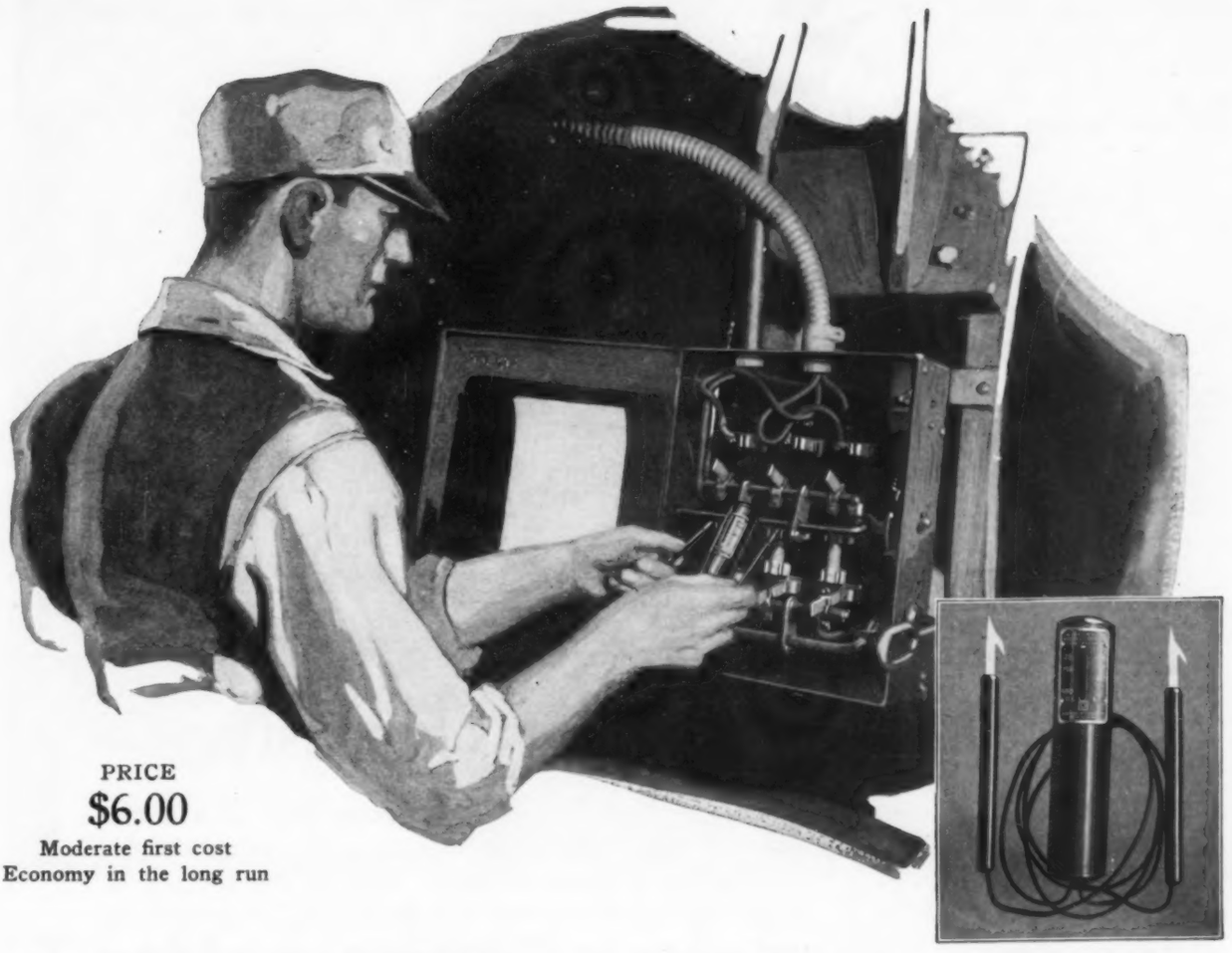
Any office will gladly furnish specific information.

Benjamin Electric Mfg. Co.

NEW YORK
247 W. 17th Street

CHICAGO
120 S. Sangamon Street

SAN FRANCISCO
580-582 Howard Street



PRICE
$6.00
Moderate first cost
Economy in the long run

A Brand New Voltage Tester

Shows whether current is A.C. or D.C.— indicates voltage—and requires no lamps

Here is a brand new type of voltage tester—a Square D product—which indicates ACTUAL VOLTAGE, and does away with troublesome, costly lamps.

It also shows at a glance whether current is AC or DC —which a lamp will not do.

The Wigginton Voltage Tester, as offered by Square D, comes in one compact, pocket size that can be used for all low tension circuits up to 600 volts.

Everyone who has worked on electrical circuits knows the disadvantages of the devices formerly used for estimating voltages—the constant breakage of lamps, the different sizes of lamps that must be carried for different voltages, the inaccurate suggestion of voltage obtained from the brilliance with which the lamp burns.

This new instrument is infinitely superior in every way to other types now in use. It is easy to carry, simple to operate. A plainly marked scale gives the reading in a few seconds. There is nothing to break or get out of order—the tester is enclosed in a light but rugged fibre housing.

The Wigginton Voltage Tester is easy to use. It entirely replaces lamps in locating open circuits, blown fuses and motors running single phase. It may be used in emergencies as a voltmeter.

Anyone working on electrical circuits—electricians, contractors, trouble men for central stations, municipal and underwriters' inspection—will find this new Square D product invaluable.

Order from your jobber.

SQUARE D COMPANY, DETROIT, U. S. A.
FACTORIES AT: DETROIT, MICH., PERU, IND.
SQUARE D CO., CANADA, LTD., WALKERVILLE, ONT.
BRANCH OFFICES: Toronto, Montreal

BRANCH OFFICES
Boston Buffalo
Chicago New York
Pittsburgh St. Louis
Philadelphia Cincinnati
Milwaukee Atlanta

BRANCH OFFICES
Cleveland San Francisco
Los Angeles Syracuse
Kansas City New Orleans
Baltimore Columbus
Minneapolis Indianapolis

Square D

(64)

MANUFACTURERS OF THE SQUARE D SAFETY SWITCH

KEYSTONE ACCOMPLISHMENTS

No. 4 of a series

"Your number 3 and 4 Keystone Grease used in connection with the Venango cups has given such satisfaction that we would like to have our stock house equipped as soon as possible with these cups.

"We have at this time about 450 cups in use.

"We find that the gravity grease system has saved us at least 55% over lubrication with oils."

. . .

"We were very skeptical about what your representative claimed Keystone Grease would do for us when he first called on us, yet we equipped all of our shafting and some of our very fast running machines with your Keystone Cups and Grease; in fact, we use it on all our motors. Many of these have not been refilled after fourteen months of constant use, and we are highly pleased with the service they have given us. In fact, the grease lasts longer and the cups do not require filling even as often as your representative claimed."

. . .

"We have been using the Keystone Grease for about one year, and we find it the most economical lubricant we have ever used. We believe it will save at least 50% of our oil bill, and we have not had a hot box since we commenced using the grease."

. .

"In using Keystone Grease on a fan running continuously for 72 hours, we found that it required only 1½ oz. of grease as compared with 3 pints of oil for the same length of time.

"Cost of oil $0.11-25/100; cost of grease $0.1-40/100. Efficiency of grease over oil 704%."

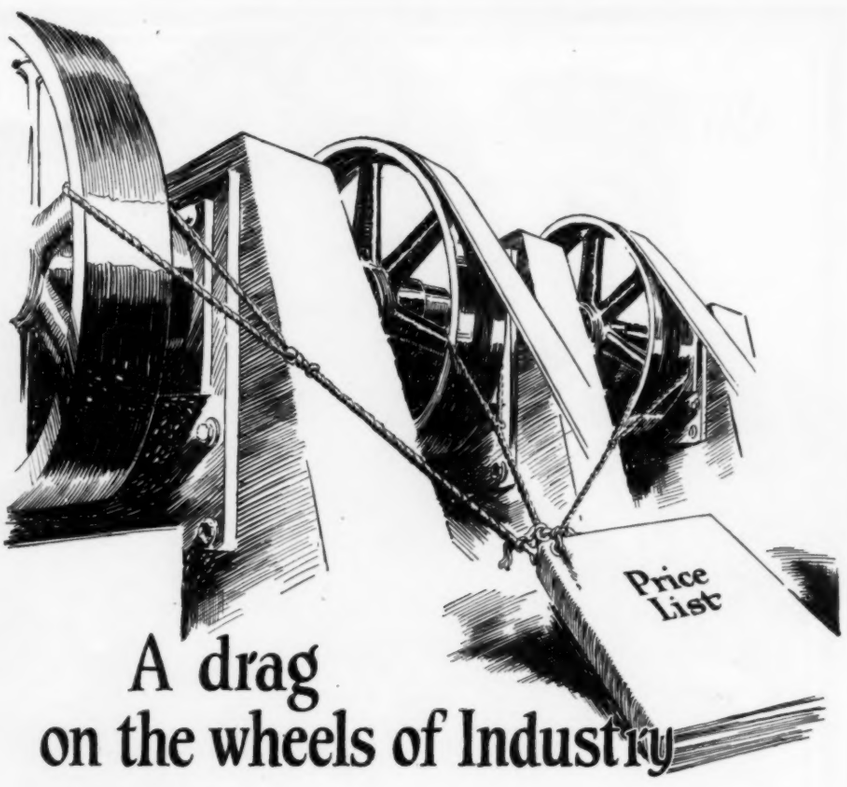
. . .

"We have been using Keystone Grease for the last five years and find it to be the best of all greases that we have ever used, and we have used all the different makes of grease. Your grease may cost a little more than others, but it is the cheapest, for you need only about one-half as much, or less than any other grease made."

. . .

Above are five of Keystone's accomplishments in lubrication cost reduction—we could quote five hundred. Why not talk to a Keystone Sales Engineer—no obligation—write!

KEYSTONE GREASE



A drag on the wheels of Industry

COST reduction isn't in a "price list." It's in the extra power released for increased production, the elimination of those frequent trips to the scrap pile, costly repairs, shutdowns and slowing up of production that only the use of a high quality lubricant, such as Keystone Grease, makes possible.

Keystone Grease is a pure petroleum grease, made in densities to lubricate everything from high-speed power transmission to heavy-duty machinery, under adverse conditions of temperature or moisture. It is as honest a lubricant as can be made and will save from three to four times its cost. THE KEYSTONE LUBRICATING CO., *Est. 1884,* PHILADELPHIA, PA., *at 21st & Clearfield Streets.*

Keystone Grease

The Master Lubricant

For Every Industry

Reg. U. S. Pat. Off.

The magnets were installed under the direction of J. H. Gallagher, captain of the GRIFFIN. Captain Gallagher says a crew of 40 longshoremen would be required to do the work of the two magnet cranes.

The two C-H 45-in. Red Magnets are part of the equipment of the Steamer Griffin.

Two Magnets Do Work of 40 Longshoremen

C-H 45-in. *Red Magnet unloading pig iron from hold.*

Magnet and Crane Equipment Paid for in Year

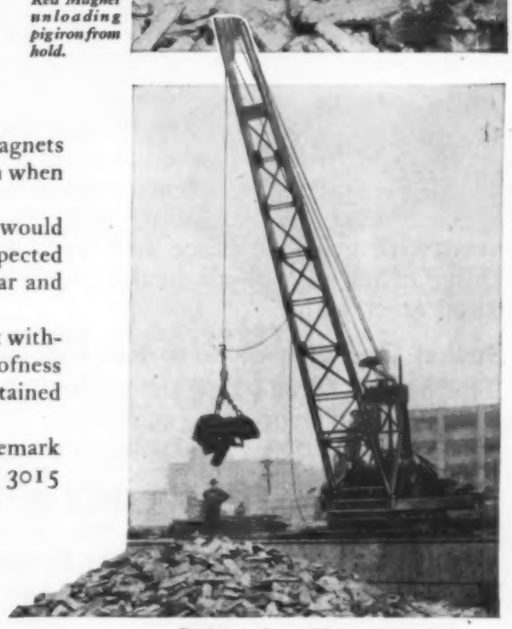
The experience the Charcoal Iron Company had with C-H Magnets on the Steamer Cicao in 1916 led to their use on the Steamer Griffin when this company resumed pig iron shipments this year.

The captain, J. H. Gallagher, says a crew of 40 longshoremen would be required to do the work of the two magnets and cranes. The expected saving of the entire investment has been accomplished in one year and time of loading and unloading reduced.

Wherever magnets are subjected to all kinds of weather and must withstand continuous service, the ruggedness, water-and-weather proofness of Cutler-Hammer Magnets are of particular value. Their sustained lifting capacity is important for any magnet service.

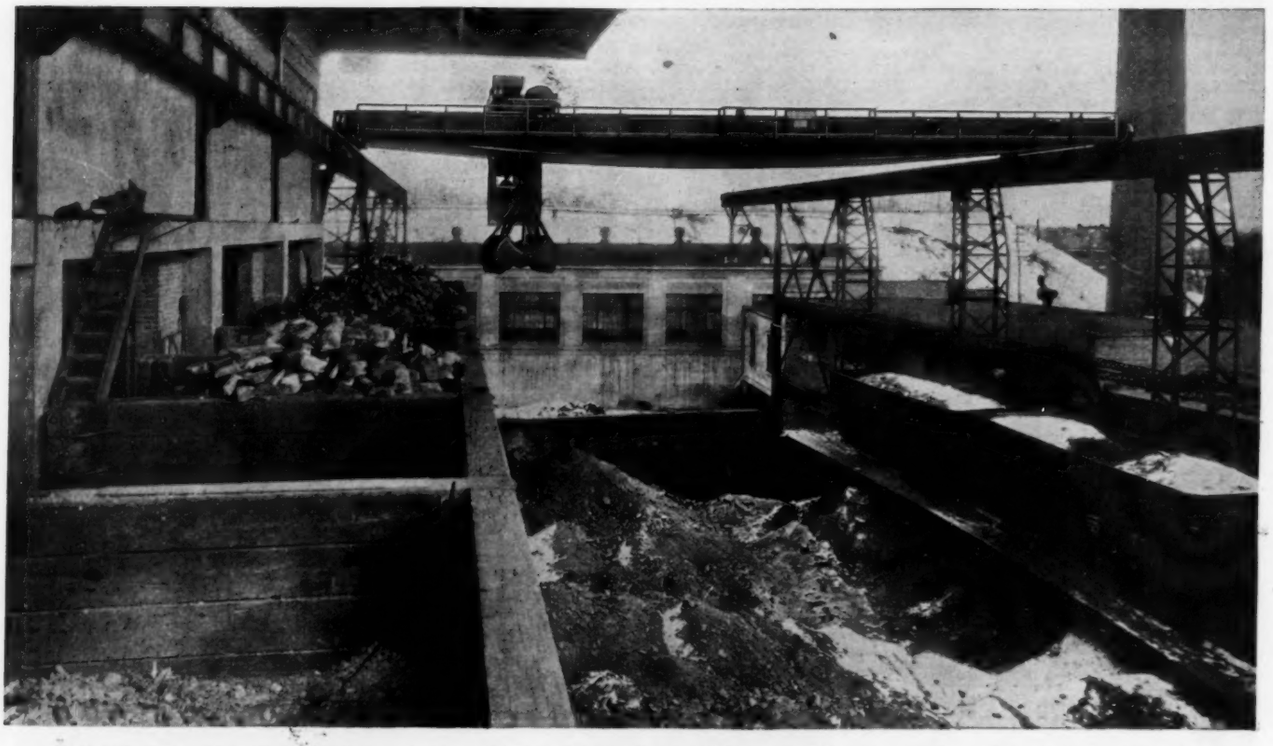
All Cutler-Hammer Lifting Magnets carry the name and trademark —they are coated with rust-resisting red-oxide paint. Publication 3015 gives all details.

THE CUTLER-HAMMER MFG. CO.
Magnet and Clutch Department
Works: MILWAUKEE *and* NEW YORK
Offices and Agents in Principal Cities
Northern Electric Co., Ltd., Canada



Pig iron is dropped by magnets to dock or cars, or carried from dock to vessel.

C-H CUTLER-HAMMER **RED LIFTING MAGNETS**



P & H Combination Grab Bucket and Magnet Type Crane, for handling coke, limestone, slag, pig and scrap iron, etc.

You Can Always Count on Steady Service and Low Maintenance Cost

The P & H Electric Traveling Crane with grab bucket and magnet for steel mill and foundry yard service, is built in accordance with the strict requirements of heavy duty.

These cranes are designed throughout with special attention to accessibility—bearings are bronze bushed and cast integral to pressure alignment, through-bolts are used exclusively, shafts may be removed with gears in place and without disturbing other parts—all braking is accomplished electrically.

Bucket Operates Close to Runway Rails

The design of the P & H trolley permits picking up and depositing materials close to either runway rail, a valuable feature particularly where runways run parallel with building walls.

P & H Grab Bucket Cranes and Hoists are used by such companies as the Illinois Steel Co., Wisconsin Steel Co., The McKinney Steel Co., Wm. Wharton Jr. & Co., Tennessee Coal, Iron & R. R. Co., Weirton Steel Co., Whitaker Glessner Co., Crucible Steel Co., Inland Steel Co., Universal Portland Cement Co.

Our Bulletin 305 tells all about the quality of P & H design, materials and construction. A copy will be forwarded on request.

Hoist and Crane Division

PAWLING & HARNISCHFEGER CO.

Established in 1884

3855 National Ave., Milwaukee, Wis.

New York, Atlanta, Detroit, Kansas City, Chicago, Portland, Memphis, Dallas, Seattle, Philadelphia, Pittsburgh, Los Angeles, San Francisco

P&H GRAB BUCKET CRANES

AIR!

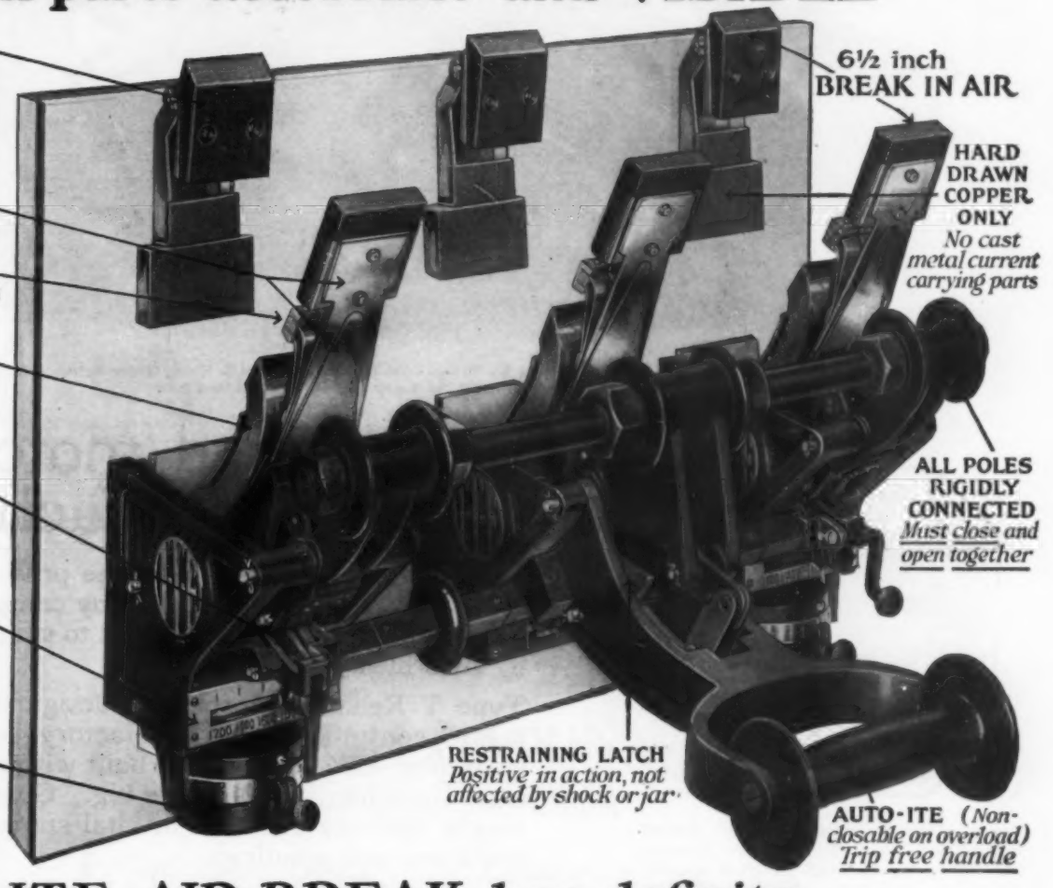
I-T-E CIRCUIT BREAKERS

For Alternating Current

600 VOLTS OR LESS

Give protection without complication

All parts accessible and VISIBLE

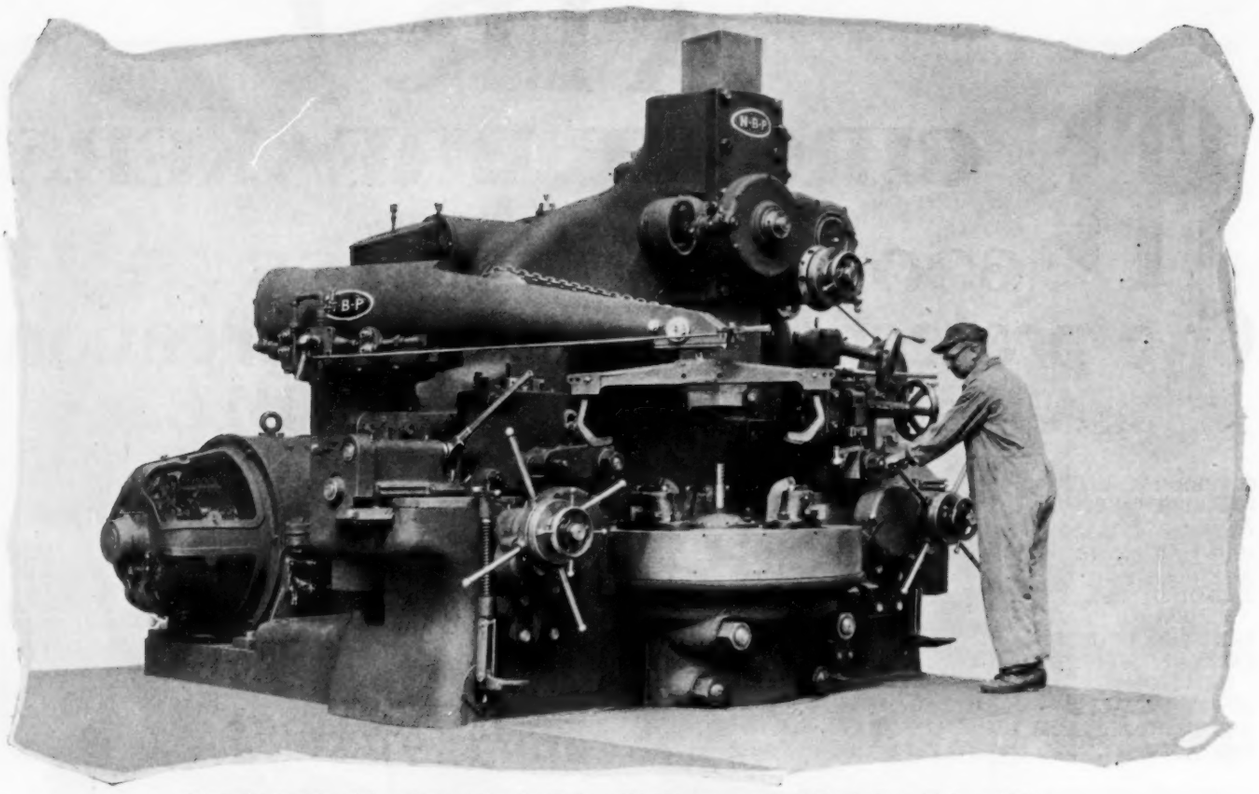

COPPER JACKETED PRESSURE CARBONS
For initial contact and final break
Mechanically strong
Electrically perfect
PHOSPHOR BRONZE CARBON SUPPORTS
HEAVY METALLIC SECONDARY BREAKING CONTACTS
LAMINATED BRIDGE
Each leaf individually formed - Heavy even pressure on every Lamination
CLOSING TOGGLES
Afford heavy contact pressure with easy closing
OVERLOAD
Direct acting. Long scale calibration. No relays or series transformers
DALITE
(Direct acting time limit) feature. Adjustable from zero to maximum time. No relays
6½ inch BREAK IN AIR
HARD DRAWN COPPER ONLY
No cast metal current carrying parts
ALL POLES RIGIDLY CONNECTED
Must close and open together
RESTRAINING LATCH
Positive in action, not affected by shock or jar
AUTO-ITE (Non-closable on overload)
Trip free handle

I-T-E AIR BREAK has definite advantages not present in the oil breaker

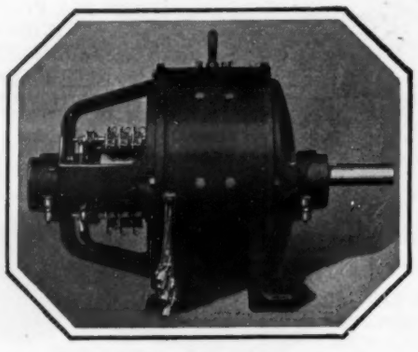
1. *No oil — to leak, carbonize, burn or explode — Just air.*
2. *No tanks to conceal anything — or the lack of it.*
3. *No cells — nothing which needs or deserves to be imprisoned — Just a faithful and efficient servant.*
4. *Inherent simplicity — with resulting low cost of installation and maintenance.*

The CUTTER I-T-E COMPANY

ESTABLISHED 1888 PHILADELPHIA



N-B-P Vertical Car Wheel Lathe driven by 75 hp., 300-900 r.p.m. Type T Heavy Duty Reliance Motor. Auxiliary motors 1 hp., 1150 r.p.m. and ½ hp., 1150 r.p.m.



The development and design of Type T Reliance Motors were unusual in that we received the active co-operation and assistance of 35 steel mill electrical engineers. As a result these motors embody the ideas of men who know the need for quality and strength in every motor detail.

Rugged motors for husky machines

Modern tools like this make the production records of past years look insignificant by comparison. Rugged driving motors are essential to stand the pace set by such husky machines.

Type T Reliance Motors are designed and built to insure continuous and satisfactory service on just such jobs. End brackets are built with extra strength, shafts are big, bearings are big. Good materials in ample quantity are used in vital spots such as commutators and windings.

Complete illustrated evidence that Type T motors are made to deserve the term "heavy duty" and to do more than meet ordinary needs, will be found in our Bulletin 2014.

RELIANCE ELECTRIC & ENGINEERING CO.
1080 Ivanhoe Road, Cleveland, O.
Branches: Boston, New York, Philadelphia, Pittsburgh, Cincinnati, Detroit, Chicago, Birmingham, Ala.

Type T Heavy Duty
RELIANCE MOTORS
Direct Current

Four Years Gear Cost

Nuttall BP Gears are guaranteed to last four times as long as ordinary untreated gearing in identical service.

4 Untreated gears @ $35		$140.00
Labor cost, 3 renewals @ $7.50		22.50
Gear cost, four years		$162.50

or

1 Nuttall BP Gear	$42.50	
Installation and renewal	7.50	50.00
Saving in favor of BP		$112.50

That is guaranteed. Enough said? Is there any reason **whatever** for not using BP Gears?

Complete literature on the subject is at your disposal gratis. Where shall we send it?

R.D. NUTTALL COMPANY
PITTSBURGH PENNSYLVANIA

Philadelphia Office
420 Land Title Bldg.

Chicago Office
2133 Conway Bldg.

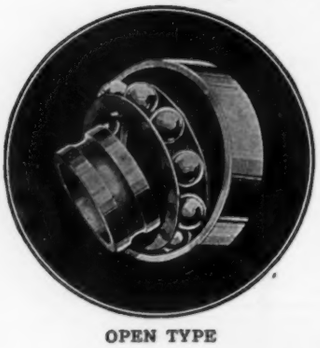
Nuttall

PRECISION BEARINGS

Make Good Machines Better

They strengthen what are often the weak parts in the structure—the shaft and spindle bearings. They minimize a prolific cause of trouble—friction and wear in the bearings. They reduce power consumption and oil consumption. They contribute materially to longer life, better performance, lower upkeep, increased and improved production.

"NORMA" PRECISION BALL BEARINGS

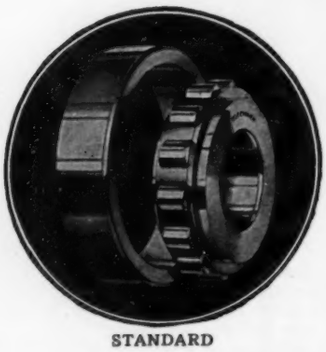


OPEN TYPE

Experience has proved the preeminent superiority of these high precision units under conditions where maximum serviceability and freedom from vibration under high-speed operation are essential. They have all the load-carrying capacity of any ball bearing, combined with a speed-ability which no other ball bearings have. For years past, they have been the standard bearings in tens of thousands of high-speed machines operating under severe conditions. They are increasingly in demand for high-speed grinders and drills, precision measuring devices, electric tools, fractional hp. motors and small generators.

CLOSED TYPE

HOFFMANN PRECISION ROLLER BEARINGS



STANDARD

Designed for conditions involving heavy loads, hard service, shock, jar and vibration, these high-precision, heavy-duty units have proved their entire success. They have all the speed-ability of the best ball bearings, with a much greater steady load-carrying capacity than any ball bearing and with a temporary overload capacity, as under shocks or in starting, which no ball bearing has. They are made in both standard and self-aligning types—some of the latter being wholly enclosed, lubricant packed and dust-and-moisture-proof. They are the preeminent bearings for high-duty, heavy-duty machines from which the utmost is demanded.

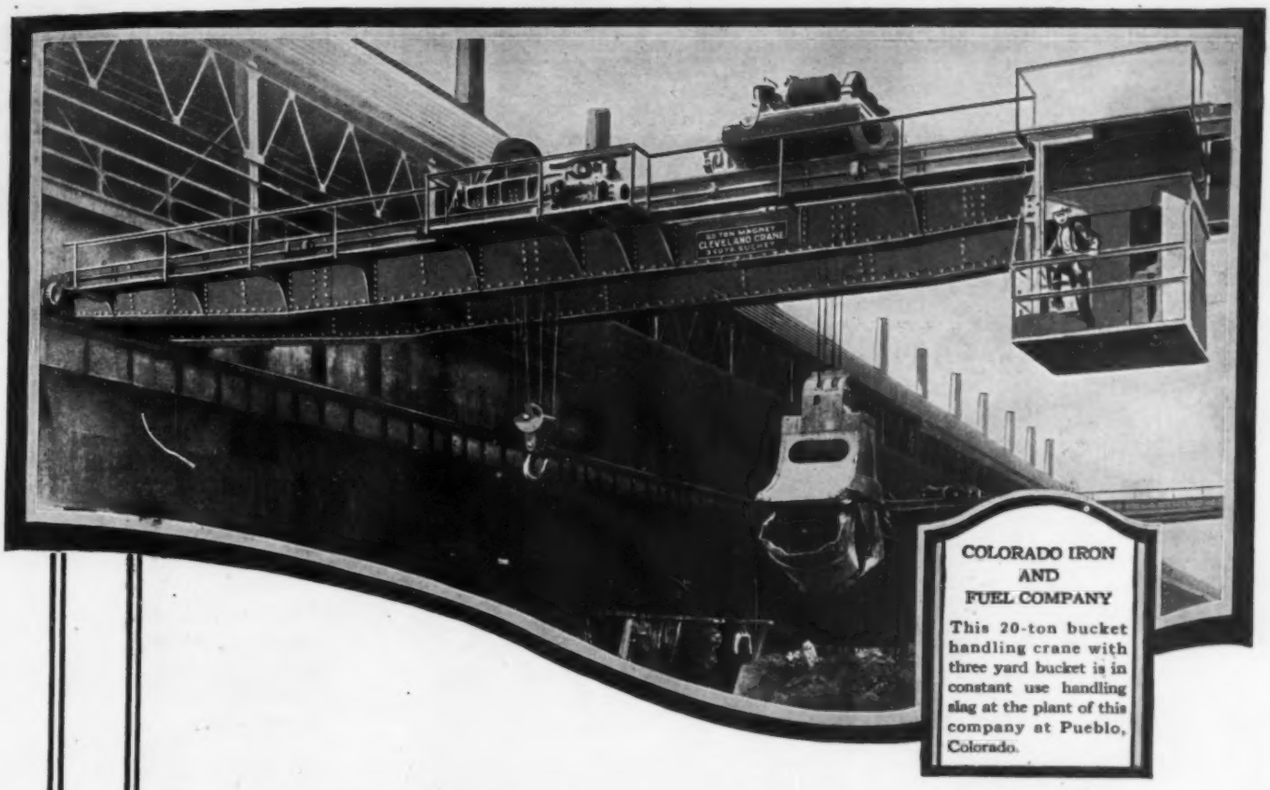
ENCLOSED SELF-ALIGNING

"NORMA" engineers will welcome an opportunity to work with yours in applying these high-precision bearings to the machines you make or use.

THE NORMA COMPANY OF AMERICA

Anable Avenue Long Island City New York

BALL, ROLLER AND THRUST BEARINGS



COLORADO IRON AND FUEL COMPANY

This 20-ton bucket handling crane with three yard bucket is in constant use handling slag at the plant of this company at Pueblo, Colorado.

Bulk Materials in Quantity

Volume is the important factor in the economical handling of bulk materials. Continuous operation of the crane and bucket is essential and that means freedom from repairs and delays. Speed and low maintenance cost are likewise linked with crane design that reduces wear and makes inspection easy.

Cleveland Bucket Handling Cranes are simple, accessible and rugged. Bridge, trolley and hoist are as free from complicated mechanism as can be designed to do the work required. Motors, gears, drums and shafts are easily inspected and quickly removable in emergencies. The entire assembly is strong and rugged with every possible provision for the continuous operation which is necessary for the economical handling of bulk materials in large quantities.

The wide experience of Cleveland Crane engineers is available to every bucket crane user. Much valuable information on handling bulk materials may be had for the asking.

THE CLEVELAND CRANE & ENGINEERING CO.

New York City
30 Church St.

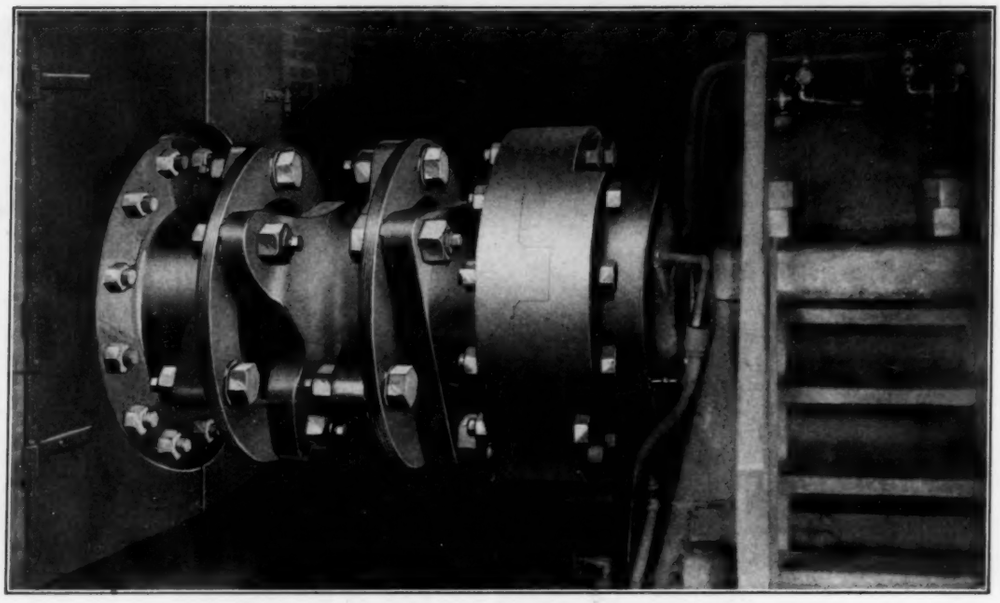
WICKLIFFE OHIO.

Pittsburgh
511 Farmers Bank Bldg.

CLEVELAND CRANES

THOMAS FLEXIBLE COUPLINGS

FOR MAIN ROLL DRIVES



Thomas Mill Type Coupling on 84" Plate Mill, 2500 H.P., 235 R.P.M.
Youngstown Sheet & Tube Company

Above coupling and another on the 5,000 H.P. 197 R.P.M. 132" plate mill drive at this same plant have operated a total of six years with absolutely no maintenance charge.

No sliding or wearing parts
No loosely connected members
No frictional resistance to end float
No lubrication
Three very accessible bolts, removal of which frees either end of drive

The Thomas coupling is the only mill spindle which has these features. The first two are the most important, as a "tight" drive eliminates all backlash and prevents the hammering action, which is so destructive to gears, bearings and shafts. The net result is an immediate reduction in maintenance costs.

Thomas Flexible Coupling Co., Warren, Pa.

SALES OFFICES: Pittsburgh Chicago Cleveland Philadelphia Boston St. Louis New York Springfield

A fuse as permanent as the panel board

The only purpose of a renewable fuse is to provide for renewal without repurchase of the whole fuse. If repurchase of the whole fuse is be avoided, the fuse case must actually *be* permanent.

Permanency, under normal conditions, depends upon:

1. **The quality and strength of materials used.**
2. **The design of the fuse itself.**

The quality of materials used in Buss fuses needs no discussion—the unusually heavy fibre case and the extra rugged metal parts are self evident.

But even with such strength of construction, permanency would not be assured except for Buss design.

Poor contact due to poor design is the chief cause of renewable fuse destruction. Buss design prevents the possibility of poor contact by avoiding designs which permit variation in the manufacture, assembly or use of the fuse.

The full length cap provides a one-piece, undivided, perfectly even surface for contact with the fuse block clips.

The firm grip of the clip keeps vibration from loosening the cap, which, therefore, maintains contact pressure on the link. The projection inside the cap gives positive bearing on the link. The recess around this projection collects expelled metal, when the fuse blows on a heavy short, thereby preventing sticking of the cap and injury to the contact surface.

By avoiding constructions that permit poor contact, Buss has added years of life to the fuse and saved thousands of dollars annually in preventing useless blowouts.

When you insert a Buss Fuse in the clips, you do it with a feeling of confidence. It is there to stay—a trusty watchman of your circuit. It blows to protect but never to cause useless shutdowns and expense.

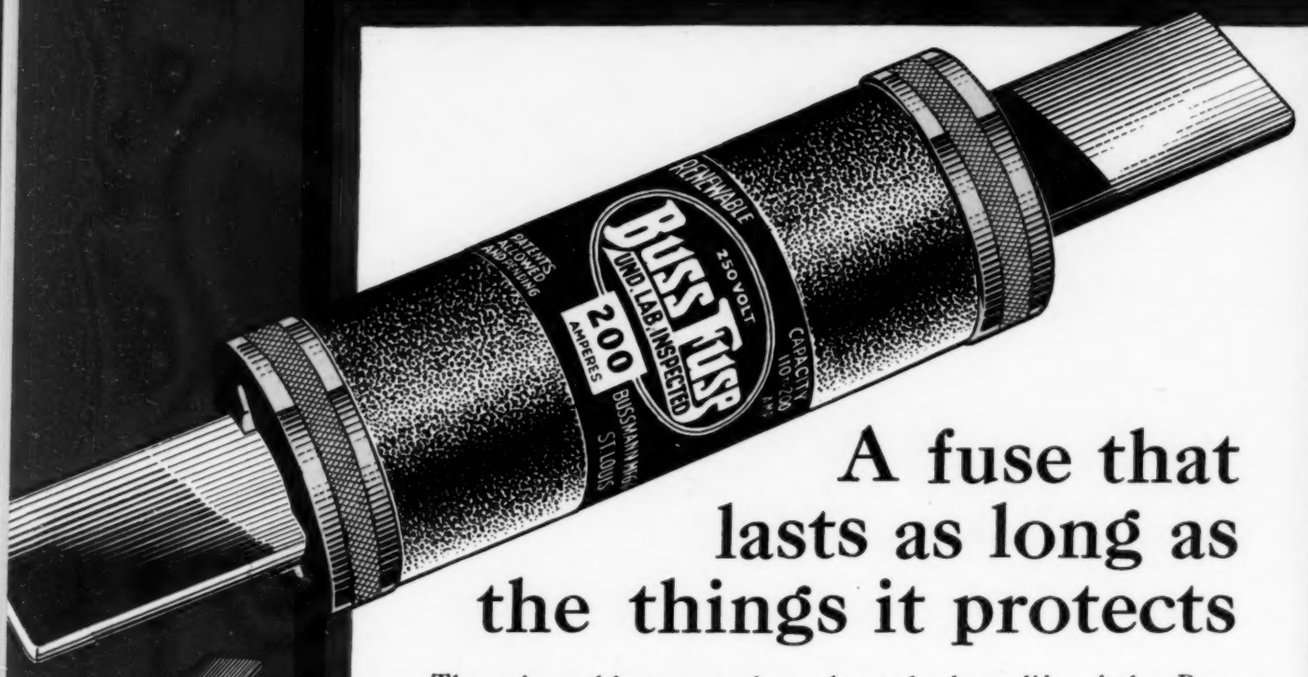
If you are not thoroughly acquainted with the BUSS Ferrule Contact Renewable Fuse, clip the coupon on the next page.

BUSS FUSES

APPROVED IN ALL TYPES AND SIZES

TRADE
BussFuses
ELECTRICITY'S SAFETY VALVE
MARK
REG. U.S. PAT. OFF.

"ELECTRICITY'S SAFETY VALVE" MEANS ONLY BUSS FUSES.



A fuse that lasts as long as the things it protects

There is nothing mysterious about the long life of the Buss Knife Blade Renewable Fuse. It results from certain common-sense features of construction that eliminate the primary causes of fuse destruction.

Buss design has first of all taken care of the human factor in fuse renewal waste. Just three parts and the link—that's all. No hinges, wings, screws or washers to handle. No tricky or annoying adjustments to make. No possibility of a Buss fuse being discarded by an inexperienced or irritated workman because of difficulty in renewing. No possibilty of premature blowouts due to link being bent or injured in renewing the fuse, because the terminal support holds the link rigid.

Injury to the case due to gaseous pressure developed by a heavy short is prevented by the knurled venting discs which insure positive, reliable and

controlled escape of gases. Sufficient pressure is retained within the case to quench the arc but enough is permitted to escape to avoid excessive pressure.

Poor contact, that greatest of all destroyers of fuses, is avoided through perfect alignment of terminals. One terminal is seated in a slotted opening just large enough to let it pass. The other terminal is accurately lined up in exact position by projections on the venting disc fitting into notches on the end ring.

The use of the Buss Renewable Fuse gives a freedom from annoyance and a satisfaction of absolute protection at the lowest possible cost, that cannot be had in any other way. It is truly the fuse whose life is as long as that of the things it protects.

If you would like to examine a BUSS Knife Blade Renewable Fuse, clip the coupon.

ANN MANUFACTURING CO.
9 No. Twenty-Third St., St. Louis, Mo.
obligation send me for examination (check which you want)
to 30 ampere, 250 volt Ferrule Contact Type Buss
renewable Fuse.
to 100 ampere, 250 volt Knife-Blade Type
Renewable Fuse.

Company
Street
Position

IE 3-24

BUSS FUSES

APPROVED IN ALL TYPES AND SIZES

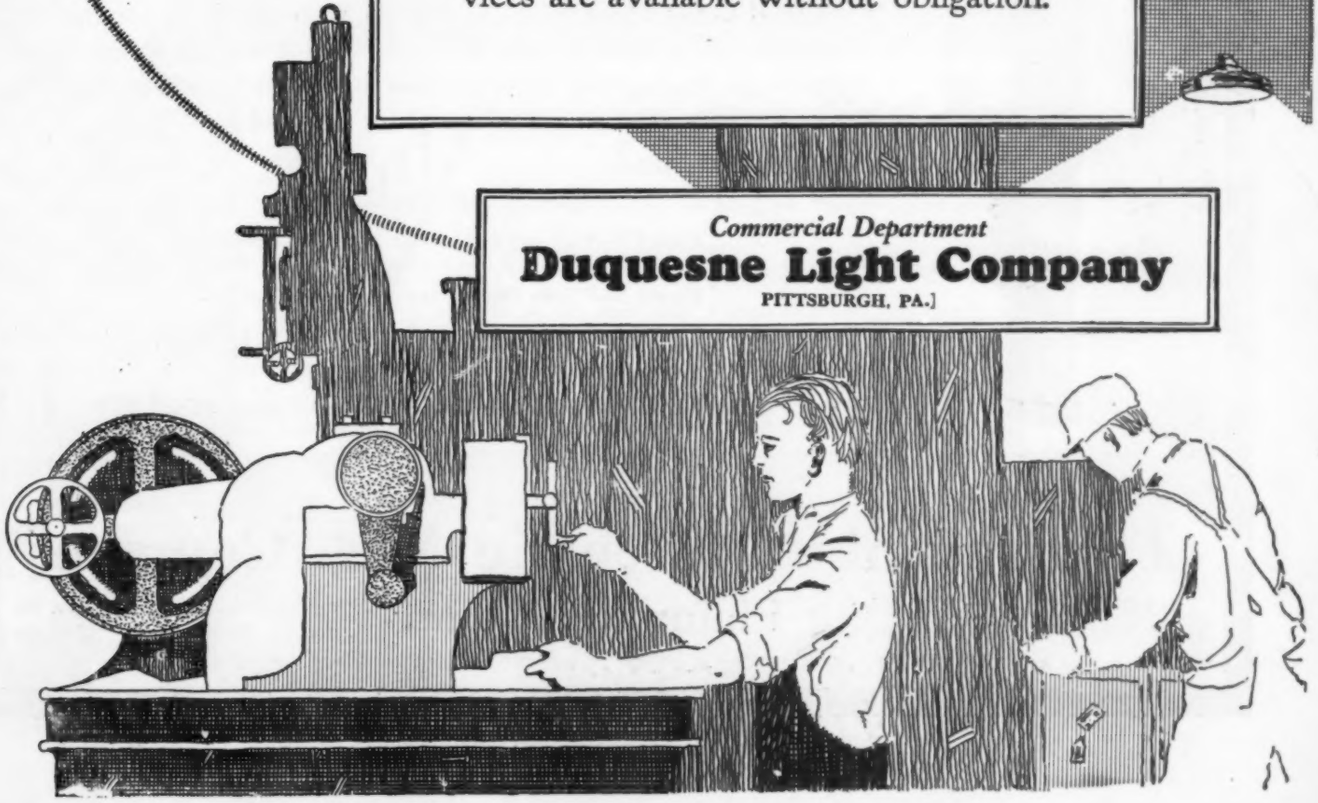
TRADE
BussFuses
ELECTRICITY'S SAFETY VALVE
MARK
REG. U.S. PAT. OFF.

CTRICITY'S SAFETY VALVE" MEANS ONLY BUSS FUSES.

Consider the EYES

IN the industrial plant keen eyesight is necessary to produce efficient work, eliminate errors and avoid accidents. To surround the workman with proper lighting is to increase his efficiency. In this age of increasing costs, greater accuracy is necessary in production.

Our Illuminating Engineer can undoubtedly suggest many ways in which your lighting can be bettered. His services are available without obligation.



Commercial Department

Duquesne Light Company

PITTSBURGH, PA.]

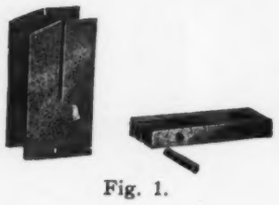


Fig. 1.

Fig. 2.

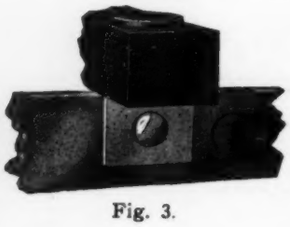


Fig. 3.

Fig. 4.

Iron and Steel Electrical Engineers:

You Iron and Steel Engineers represent probably the first body of men who individually and collectively appreciated that to obtain safety in switches something far more was necessary than just a safety box.

No body of men know better than you the unfortunate position in which safety switches have been placed because of a long drawn propaganda by salesmen and press eulogizing the safety box which keeps the operator away from the live parts of the switch. Such propaganda paid no attention whatever to the first necessity of safety in switches—namely the type of switch in the box that is to do the work.

From the beginning until now, there are few manufacturers and fewer contractors and engineers who pay enough attention to the construction of the knife switch proper, thinking as they do that safety switches mean a safety box surrounding most any kind of a switch.

Even the Underwriters in classifying safety switches speak of Class A, Class B, Class C or even Class AA in terms of boxes only—disregarding the switch entirely—an A box may contain the cheapest switch imaginable. One safe switch for industrial use is the Trumbull Type A manufactured for nearly twenty-five years. The Trumbull Type A switch is machine made—built-up, most rigidly constructed and **quick-make** and **quick-break.** It will stand up under use and abuse.

The Illustrations Show

Figure 1—Foot-block and the pin that fastens the blades to the foot-block after it has been sweated.

Figure 2—Shows contact jaw complete.

Figure 3—Shows method of fastening the blade to the fibre cross-bar, making a unit of the blade and crossbar.

Figure 4—Shows long and strong quick make quick break spring that at no time is worked more than 50 per cent of its capacity.

The Trumbull Electric Mfg. Company

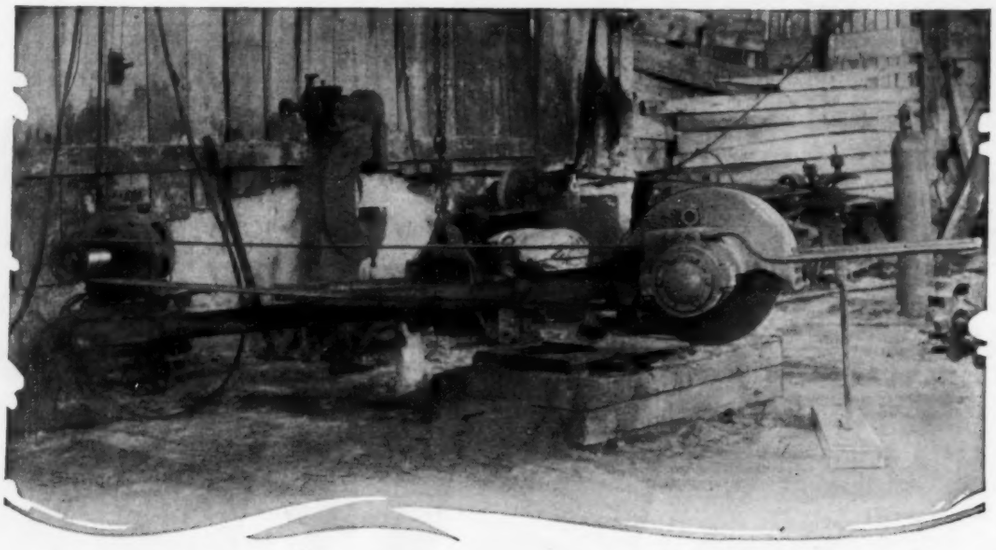
114 Liberty St., New York City
595 Mission St., San Francisco, Cal.

Plainville, Conn.

2001 W. Pershing Rd., Chicago, Ill.
Boston Philadelphia Atlanta

FLOOR OPERATED
ELECTRIC HOISTS
Illustrated descriptive Price List and Catalog
SHEPARD
SINGLE HOISTING ROPE
CONTROL, D C. OR A C
SINGLE HOISTING ROPE
New
Complete Electric Hoist Book
Send for your copy
The most comprehensive book on electric hoists ever published. Prices, dimensions, specifications, installation views, descriptions—it gives every bit of information necessary for you to carefully select exactly the right hoist for your requirements.
Write us for your copy TODAY, before you forget it. It will pay you to keep this ready reference at hand.
SHEPARD ELECTRIC CRANE & HOIST CO.
382 Schuyler Avenue Montour Falls, N. Y.
Branches in Principal Cities
Member Electric Hoist Mfrs.' Assn.
REG. U.S. PAT. OFF.
SHEPARD
ELECTRIC CRANES & HOISTS

SKF



No Coaxing Needed on Hard Jobs
with Ball Bearing Swing Frame Grinders

THERE'S no time lost coaxing this huge swing frame grinder to do a job. Day in and day out it tackles the toughest work and bites right through without any danger of breakdowns or tieups for repairs.

This reliability of operation has been made possible by the use of four Skayef Self-Aligning Ball Bearings—two on the motor and two on the grinder.

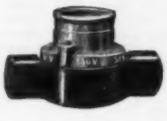
There is no visible wear after years of service and such troubles as dropped armatures, burned-out bearings and worn shafts are eliminated. Sealed housings effectively prevent the entrance of dust, grit and flying particles and retain lubricant for long periods.

THE SKAYEF BALL BEARING COMPANY

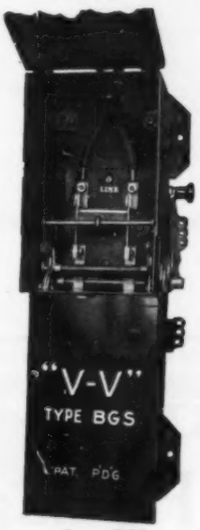
Supervised by SKF INDUSTRIES, INC., 165 Broadway, New York City

1257

Normal View *Deflected View*



"SAFETY SWITCHES FOR EVERY PURPOSE"

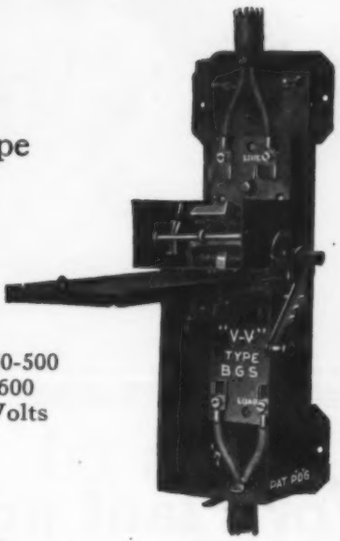


Type BGS Shows Top Casing in Place

Type BGS
Steel Mill Type

30-60
100-200
Ampere

250-500
600
Volts



Type BGS with Top Casing Removed

SAFETY
for
OPERATOR
and
ELECTRICIAN

For Use Where Occasion Necessitates Quick Replacement on Live Lines

V. V. FITTINGS COMPANY

New York
50 Church St.

PHILADELPHIA, U. S. A.

Chicago
532 So. Canal St.

Pittsburgh Representative
P. H. Schaum
933 Liberty Ave.

Cleveland Representative
S. R. Shepard
1240 Ontario St.

ALLIANCE CRANES

Largest Builders of the World's Largest Cranes

204 of 100 Tons Capacity and Over

STANDARD CRANES

55	100 tons
2	115 tons
42	125 tons
24	150 tons
22	175 tons
2	200 tons
1	225 tons
1	250 tons
3	430 tons

STRIPPING CRANES

8	100 tons
1	125 tons
19	150 tons
13	200 tons
1	Single Ram, 320 tons

COMBINATION CHARGERS AND STRIPPERS

3	100 tons
3	150 tons
4	200 tons

For Plant and Yard Haulage

Iron and steel mills should know more of the economies of Ironton locomotive service for the interior and yard operations which are usually performed by a dinkey.

With the smallest two-ton Ironton of 18" gauge to the largest 30-ton of standard gauge, haulage costs are cut to a minimum.

The operator of an Ironton locomotive need not be skilled to be efficient, and fuel as well as general upkeep cost are far below those obtaining on other types of locomotives.

Safety and economy of Irontons in operation among men and materials are well established by their highly satisfactory service in the hands of over five hundred industrial and mining companies.

Let an Ironton Sales Engineer make his survey and report before buying locomotive service.

THE IRONTON ENGINE CO.

Ironton, Ohio

ESTABLISHED 1895

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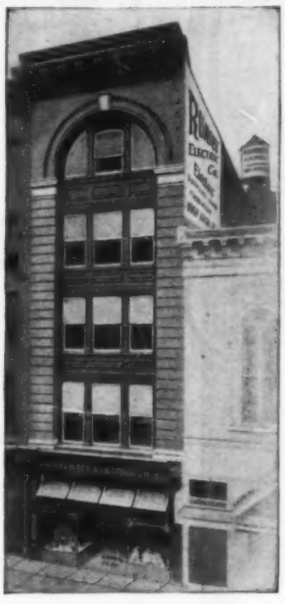

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Pointing to a good thing—

LOOK at this Roller-Smith SD Voltmeter. Note the long scale, clear cut figures, uniform scale divisions and the well-designed pointer.

Add to these features the black rubberoid finish and the plain case without fancy trimmings to tarnish and cacth dirt and dust and you wlil agree that Roller-Smith instruments are good to look at. And don't forget—*they are as good as they look.*

Bulletin AK-430 contains full details of Roller-Smith D C Switchboard instruments, 7½ in., 9 in. Horizontal Edgewise and Illuminated Dial.

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Few Parts Simplify Renewal

Simplicity Plus Strength

The few parts in a "Union" Fuse make it extremely simple to replace a blown link. The whole fuse can be taken apart and reassembled before a new link can be inserted in many other fuses.

That's an important point to be considered in the choice of "renewable" fuses. Better buy the non-renewable kind and save on first cost, if your workmen find renewals so difficult that they scrap the whole fuse after a blowout.

There's unusual strength and ruggedness in every one of the parts in a "Union."

That is why they withstand the greatest number of blowouts. And this feature, plus ease of renewal, are the reasons why

The "Union" is a good, dependable fuse.

"Union" Renewable and Non-Renewable Fuses are sold by jobbers and dealers.

Send for a copy of our new catalog. It's full of up-to-date fuse facts.

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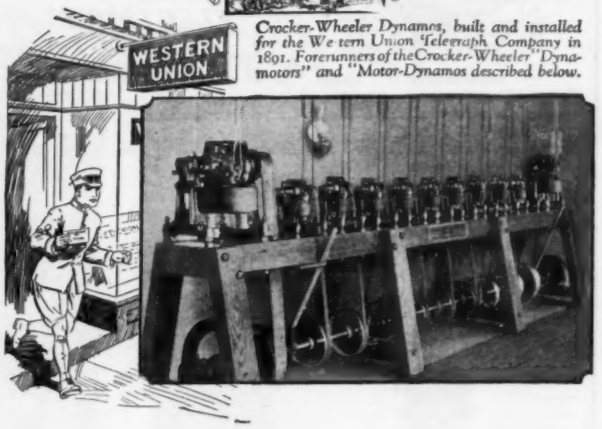
Manufacturers also of Switch and Outlet Boxes, Cut-out Bases, Fuse Plugs, Fuse Wire and Automobile Fuses

CHICAGO—NEW YORK

CROCKER-WHEELER

PIONEER MOTOR MANUFACTURERS
Established 1888



Crocker-Wheeler Dynamos, built and installed for the Western Union Telegraph Company in 1891. Forerunners of the Crocker-Wheeler "Dynamotors" and "Motor-Dynamos described below.

Every "Motor-Dynamo" replaced from 600 to 3000 battery cells!

A Crocker-Wheeler contribution to the modern telegraph system

A marvel of efficiency—the modern telegraph system!

A marvel, too, in 1891—but not a marvel of efficiency, as we regard efficiency today.

Back in 1891, wet battery cells supplied current for the two big telegraph companies—Western Union and Postal. Thousands, tier upon tier,—at a single station. Bulky—hard to maintain—costly. $1.00 per cell, per year was the cost of maintenance!

Then the Crocker-Wheeler Company was called in.

First, the ⅙ H. P. dynamos shown above were developed. Later—the "Dynamotors". And then—the "Motor-Dynamos", in common use today. A single "Motor-Dynamo", taking up the space of about two battery cells only, replaced anywhere from 600 to 3000 cells.

The annual saving, year after year, runs into thousands upon thousands of dollars!

Today, as throughout the years past, the Crocker-Wheeler Company conspicuously serves industry in many ways. Its facilities and incomparable experience are always available for your benefit.

Crocker-Wheeler Motors and Generators are built in a wide variety of types and sizes to meet practically every requirement.

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Foreign Distributor: International Western Electric Co.

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We are prepared to furnish your requirements in the following materials and equipment:

"MORGANITE" Carbon-Graphite Metal Brushes.

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We have a corps of expert engineers, specialists in the above lines, who will be glad to give immediate attention to your inquiries or to see you at your request for consultation regarding applications or equipment. Call or write our nearest office.

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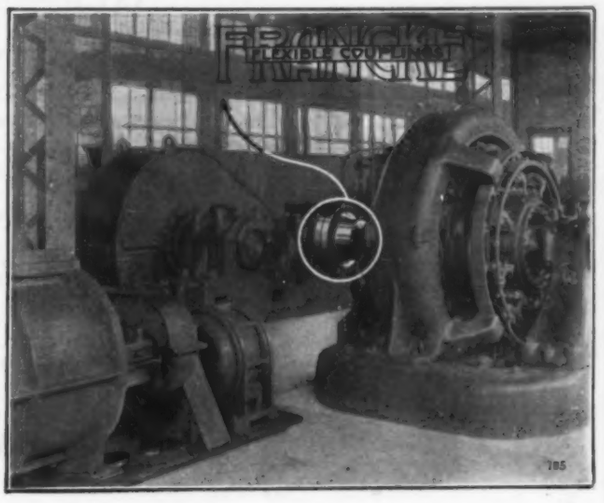
FRANCKE
FLEXIBLE COUPLINGS

"They make good machines last longer"



Francke flexible couplings save needless installing and operating-trouble costs. They are flexible in all directions. They are all-metal and durable. And in addition they provide a spring cushion for load shocks, vibrations, etc.

As with any coupling, the shafts should be lined up accurately when installed. With a Francke this is quite easy. Simply use a straight edge across the flanges at three points each about 90 degrees apart, and also measure the spacing between flanges at similar points.

To take care of all of the conditions usual with the many kinds of direct drives there are five different types of Francke flexible couplings—sizes to transmit from ¼ H.P. to 8,700 H.P. Depending upon operating conditions, some of these should be lubricated. In most cases a Francke needs no other attention after it is installed.

By removing the strains otherwise resulting from misalignment and by providing a spring cushion for shocks, Francke flexible couplings make good machines last longer.

Ask for Bulletin No. 37

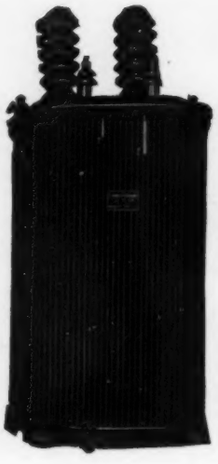
SMITH & SERRELL

Coupling Specialists Since 1912.

64 Washington Street, Newark, N. J.

District Office, Fulton Building, Pittsburgh

MOLONEY
TRANSFORMERS



WE have been manufacturing transformers now for over a quarter of a century—a long time in an industry so young.

Moloney Engineering Experience has dealt with the transformer in every phase of its development.

From the first, Moloney Engineers have been animated by a two-fold purpose: to build the highest attainable quality, and to build it economically.

Moloney Transformers are recognized by all transformer users as the highest standard—a fact which demonstrates the success which has crowned the efforts of Moloney Engineers.

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LAPP HIGH VOLTAGE PORCELAIN

Did you ever hear of a failure of a Lapp Insulator?

Seven years of production—including highest voltage pin and suspension types —without a failure!

There is the reason for use of Lapp Insulators, besides which—for "trimmings" —they provide unexcelled mechanical strength.

Lapp vacuum process of porcelain production, surfaces of porcelain glazed all over, Lapp over potential test methods.

Lapp Insulators Do Not Fail?

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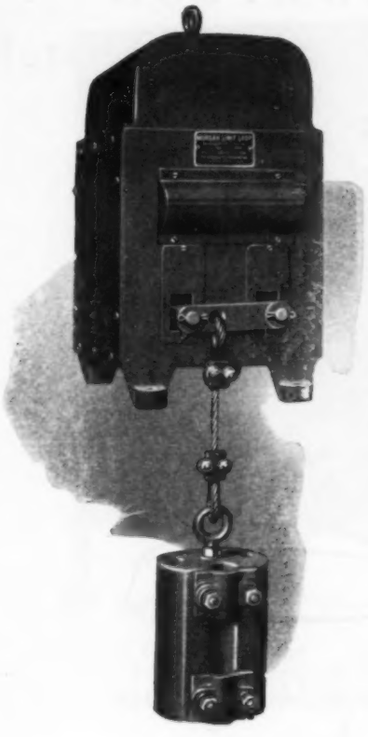

Morgan Safety Limit Stop

WACKERLY TYPE

For All Types of Direct Current Motors

A FEW OF THE ADVANTAGES

No heavy current broken by contactors.

Limit Stop can be connected up with any standard make of controller.

No extra conductors required.

Normal lowering circuits established immediately upon reversal of controller. No waiting to lower through resistance.

No external banks of resistance. Limit Stop is self contained.

Only one swinging weight used, this being guided by one of the hoisting ropes.

Positive in action. A movement upward of weight of a fraction of an inch will actuate limit stop.

Occupies minimum floor space on trolley.

Sequence of operation of contactors obtained by simple system of levers. No cams, springs or counterweights used.

For full particulars on this stop send for Bulletin No. 29.

The Morgan Engineering Co.

Alliance, Ohio

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122 So. Michigan Ave.

NEW YORK
120 Broadway

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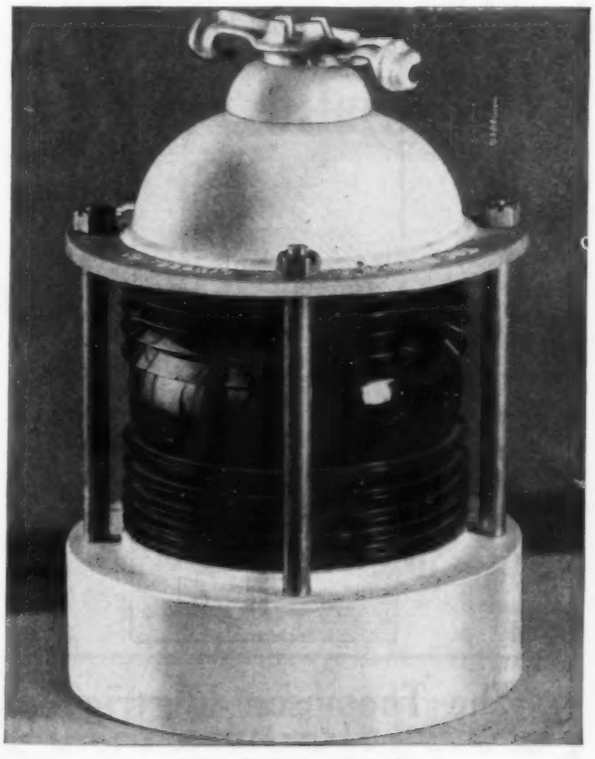
1420 Oliver Bldg.



"It takes Sand to Win"

Introducing The "Universal" Family

A new family is here—the Universal Lamps

Every member is handsome, strong and industrious and is looking for permanent employment as a warning signal in mills, at street intersections, railway crossings, stops, curves, bridges, in fact, *at any point where a danger, caution or clear signal is needed.*

This is "Big Boy" Universal, head of the house. His height is 16 inches and he does a big lamp's job—in a newer and better way, because he's rugged as all out-doors and he defies weather, acid atmosphere and roughest handling. He's made of cast aluminum — that's his secret strength, which does away with battered, corroded frames and with the elaborate "hanger" preparations that are usual with big, far-vision signals.

He dresses neatly in an 8" Corning Fresnel lens of ruby, green, yellow or clear. He has an adjustable lamp socket and carries a second bulb below as a reserve and for ground illumination. He comes with a span wire hanger or fitted for 1" pipe suspension, as desired.

We'll introduce another member of this popular family in the next issue of this publication. If you are anxious to meet the whole family at once, or think you have a job for "Big Boy", drop us a line and we'll send you the complete family history.

THE NICHOLS-LINTERN COMPANY

7960 Lorain Avenue, Cleveland, Ohio

Canadian Rep.: R'way & Power Eng. Corp., Toronto, Ont.

Nsansilwa

is the pot of hot water started up by the Bakongo native after a girl baby is born.

The one who drops the first bead into it during the first two days can claim the girl for his future wife.

It's taking an awfully long chance to pick a winner—just as long as writing for a set of Cat. No. 0½ carbon brushes to correct some brush troubles.

You may hit it right, but the odds against it are big.

How much *more* scientific it is to ask a Morgan engineer to study your service and prescribe a type of Morganite brush built *especially* for that service?

You take no chances when *our* chances for future business depend solely on the success of that prescription and our ability to *cut* your brush bills.

It's *your* move.

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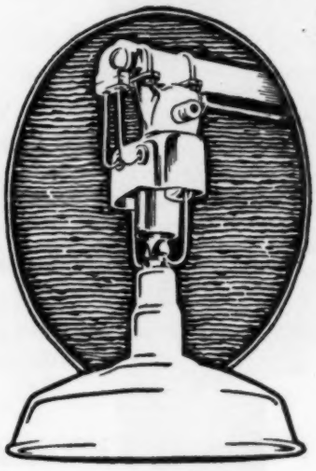
THOMPSON

Safety LOWERING Switch

or Disconnecting Hanger

"Teco" Underslung Model



makes

Lamp Maintenance

Accessible

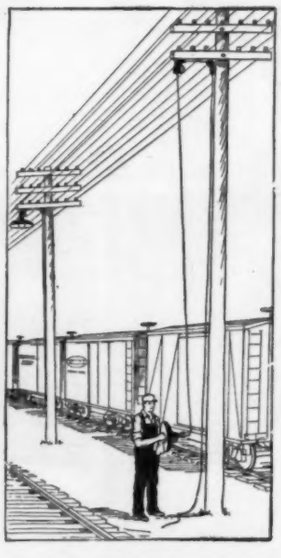
with

Ease and Safety

for both indoor and outdoor use—easily included in present lighting systems.

Get Catalog B-22

Safe



Logical

The Thompson Electric Co.
226 St. Clair Avenue, N. E.
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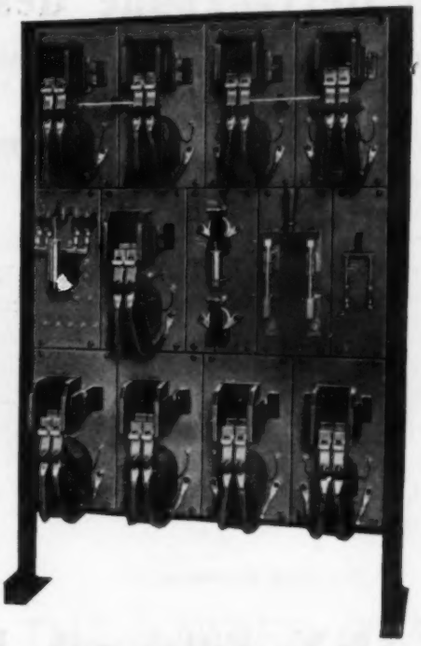

150 H.P. Type 4750 Full Speed Reversing Mill Controller

Automatic Motor Starters and Controllers

for

Alternating and Direct Current Electric Motors

May we send our nearest representative to see you?

ROWAN CONTROL

THE ROWAN CONTROLLER CO., BALTIMORE, MD.

The Mogul Type Reelite on the portable elevator permits free mobility, saves the cord, and provides safety

Take Power Where You Need It!

REELITE solves one of the troublesome problems of industry—power for the portable machine. It automatically keeps the cord clean—free from kinks and breaks—out of oil and dust—away from the wheels of trucks and the heels of workmen. It is entirely automatic, paying out and retrieving cord in lengths from 10 to 125 feet depending on the size. Cables of practically any number of conductors can be handled. Let our engineers assist you solve your cord maintenance problems.

Reelites used with portable tools increase plant efficiency

Appleton products for industry include Unilets and the complete line of Appleton Conduit Fittings

APPLETON ELECTRIC COMPANY
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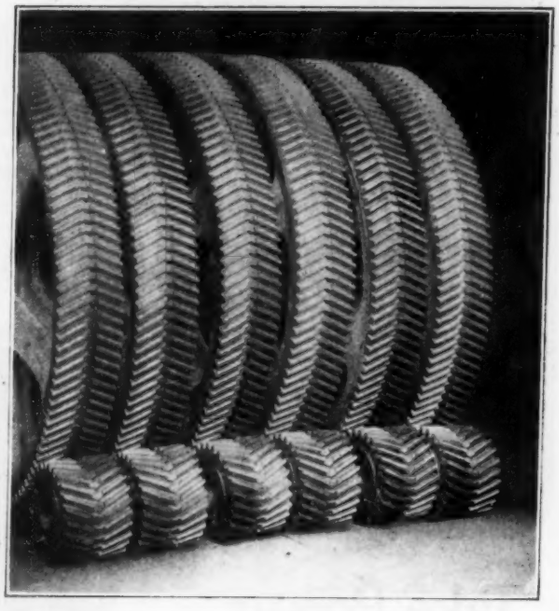
MOGUL TYPE Reelite

REG. U.S. PAT. OFF.



Fawcus Herringbone Gears

The patented machinery used in the manufacture of Fawcus Herringbone Gears has been designed to eliminate all waste motion and vibration in the finished gear and to minimize to the utmost any loss of power.

The teeth are hobbed and planed by machines which cut both halves simultaneously, insuring a perfect tooth that gives even, continuous action, and quiet, efficient service under all conditions.

Fawcus Herringbone Gears make possible large ratio reductions where spur gears would be impossible.

We build gears and gear drives of every description. Our Engineers will be glad to consult with you.

Write or wire now.

FAWCUS MACHINE COMPANY, Pittsburgh, Pa.

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MILWAUKEE, Wis., L. E. Meidinger
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Pittsburgh Transformer Company

Largest Manufacturers of Transformers Exclusively in the United States

Pittsburgh, Pennsylvania

on every brush

Dinkey Controller Contacts

Manufactured from a fine, dense, hard, carbon-graphite composition which insures you against pitting, chipping or breaking in operation and assures you of extremely long life with a minimum of care and attention. Once U.S.G. Contacts are applied, the changing of contacts becomes a rarity.

All U.S.G. Controller Contacts and Brushes are especially designed for the service intended.

Write for Catalog B-3 for complete details of the characteristics of the various grades of U.S.G. Carbon, Graphite, and Metal-graphite Products.

THE UNITED STATES GRAPHITE COMPANY

Saginaw, Michigan, U. S. A.

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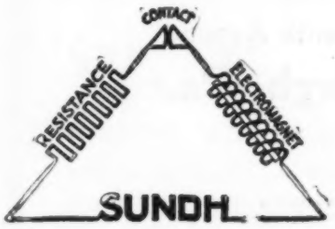
New York Philadelphia Pittsburgh Chicago St. Louis San Francisco

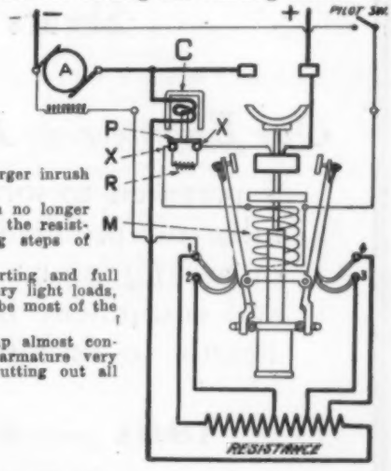


Steel Men!

Isn't this what some of you wanted, as brought out in your discussion of control in your Journal of November, 1921? A control that would have definite time limit modified with current limiting element?

You want a starter to obey its real function, don't you? i. e., to start and accelerate a motor by cutting in resistance, then out, in the shortest possible time in relation to the load. You want the motor to "mote" if it's at all possible to do so, whether the voltage is high or low, or whether there is excessive friction on a cold Monday morning. If the first current inrush does not start it, the next one may. If we can't get it to start on small amounts of current, we want to provide automatic means of increasing the current or power so that it will start, provided that no one has placed a crowbar in between the gears or there happens to be a short circuit. In that case, overload circuit opening devices take care of the condition.

We have been using this method since 1911. On large size motor starters, reversing and non-reversing, we use the multiple level starter as a pilot relay whose multi-contact energizes large shunt wound switches for cutting out starting resistance.



The action of this control is easily understood from the diagram, and the following description of operation:

The relay C is in series with the armature only during the starting period and is normally set to operate at about 130% of normal current. When the current in the armature of the motor equals or exceeds this setting on the starting inrushes, the armature of the relay lifts the plate P from the two contacts XX and by this action inserts the resistance R in series with the solenoid coil M of the automatic starter. The resistance R can be made to have a resistance so that when inserted in the circuit of the coil M (by action of excess load on the armature of motor at start) it partly destroys the effective magnetic pull of coil M and prevents the cutting out of any more resistance in the armature circuit, but at the same time there is sufficient magnetic pull to lift the core very slowly so that in time, even with the insertion of this resistance in the magnet coil circuit, the next succeeding step of resistance will be cut out, giving a larger inrush current to the motor.

Under normal conditions as soon as the current in the armature reduces to about normal, the coil C can no longer hold up plate P and it consequently drops, thus closing the circuit across contacts XX, and short circuiting the resistance R, allowing coil M to be again fully energized and to act with full power, thus cutting out succeeding steps of resistance quickly.

The retarding action caused by excess load on coil M may take place during any interval between starting and full running position. The time of the dash pot is generally set for a minimum of 1½ seconds. which in case of very light loads, the cutting out of resistance would take approximately this time, since the series relay coil C plate XX, would be most of the time short circuiting the resistance R.

Under abnormal, extremely heavy loads, where the series coil C would lift its armature and hold it up almost continuously, thus inserting all the resistance in the coil, R circuit on automatic starter coil M would lift its armature very slowly against the action of the dash pot and light pulling force, and may take up to 15 seconds before cutting out all resistance.

The resistance R may be made of a value as to either increase or decrease the pull of magnet coil M.

Write for Catalog.

SUNDH ELECTRIC COMPANY Newark, N. J., U. S. A.

1891 — 1924

MORGAN

Construction Company

Worcester, Mass., U.S.A.

Designers and Builders of

Morgan Continuous Mills

for

Billets, Sheet Bars, Skelp, Merchant-Bars, Hot-Strip, Rods

also

Wire Drawing Machines
Producer Gas Machines
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Isley Reversing Valves
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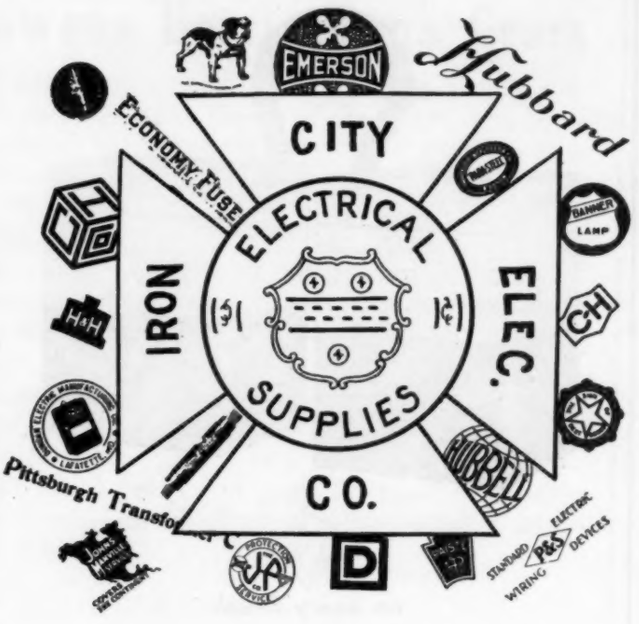
Reducing Gear Units
Shears

Our Engineering Department

is prepared to solve successfully your problems in design or arrangement of plant and equipment from open hearth to finished product

1891 — 1924



The Trade Mark

of the

Iron City Electric Co.

436-38 Seventh Avenue

Pittsburgh, Pa.

REPRESENTING

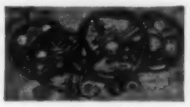
"The House That Service Built"

IS BACKED BY A GROUP OF

TRADE MARKS

of Well Known Manufacturers Guaranteeing the Quality of the Goods You Receive

Herringbone Mill Pinions



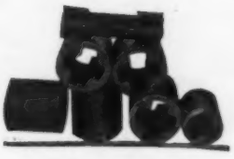
Motor and Crane Gears

Mill Table Gears

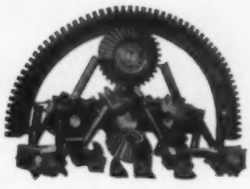
Herringbone Gears

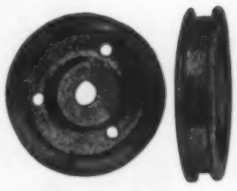
Tool Steel Face
as hard here as on the very surface (This is one of the great differences between tool steel and case-hardening methods)
Toughened Center

Cincinnati "Tool Steel" gears outlast 8 to 10 Untreated and are much stronger



Coupling Boxes and Spindles





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The Tool Steel Gear and Pinion Company

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magnet wire is particularly adapted for rewinding field and armature coils, solenoids, etc., and is used extensively in the steel industry. It is acid-proof, moisture-proof, oil-proof, heat-resisting and has an extremely tough, smooth, hard finish.

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Cleveland, Ohio	H. Lee Reynolds Company, 309 Plymouth Building
Denver, Colo.	Franklin Sales Company, Denham Building.
Los Angeles, Cal.	A. S. Lindstrom, 1144 Maple Avenue
Philadelphia, Pa.	F. K. Simons Electric Co., Fuller Building
Pittsburgh, Pa.	H. Lee Reynolds Company, Oliver Building.
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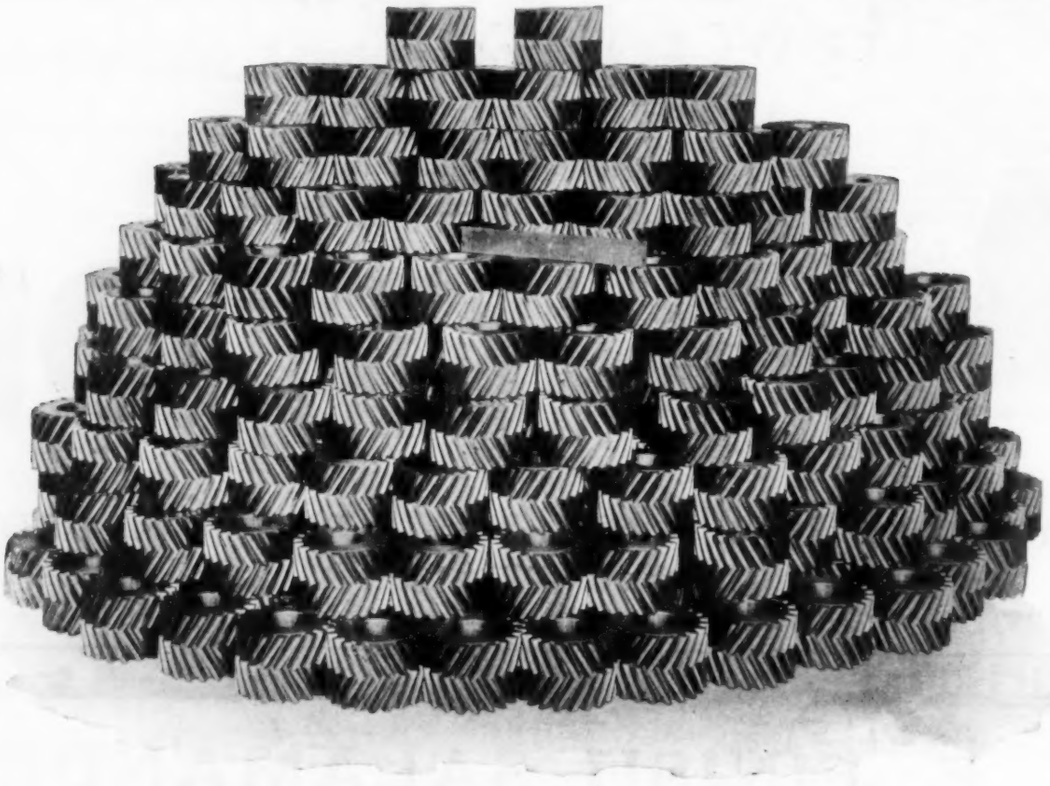

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Full information furnished on request, without obligation.

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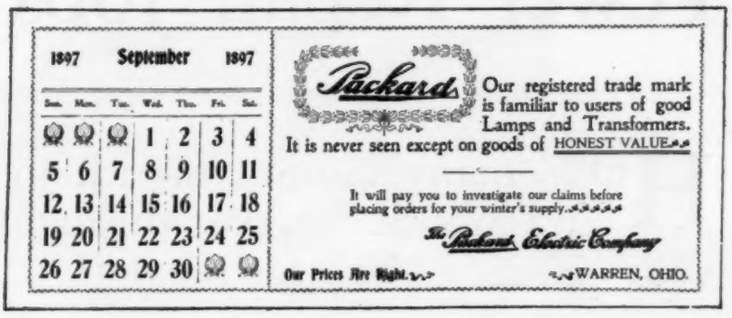
1897 September 1897
Sun. Mon. Tue. Wed. Thu. Fri. Sat.
1 2 3 4
5 6 7 8 9 10 11
12 13 14 15 16 17 18
19 20 21 22 23 24 25
26 27 28 29 30
Packard
Our registered trade mark is familiar to users of good Lamps and Transformers.
It is never seen except on goods of HONEST VALUE
It will pay you to investigate our claims before placing orders for your winter's supply.
The Packard Electric Company
Our Prices Are Right.
WARREN, OHIO.

This old blotter recently dug out of the archives by one of our good friends tells an interesting story. The true purpose of a trade mark is to give concrete expression to an ideal.

It has been our constant effort to justify the ideal so clearly established for Packard products over a third of a century ago. As evidence of our success, we refer to Packard Transformers, as we are today shipping them from our new, modern factory at Warren, Ohio. They are "of honest value".

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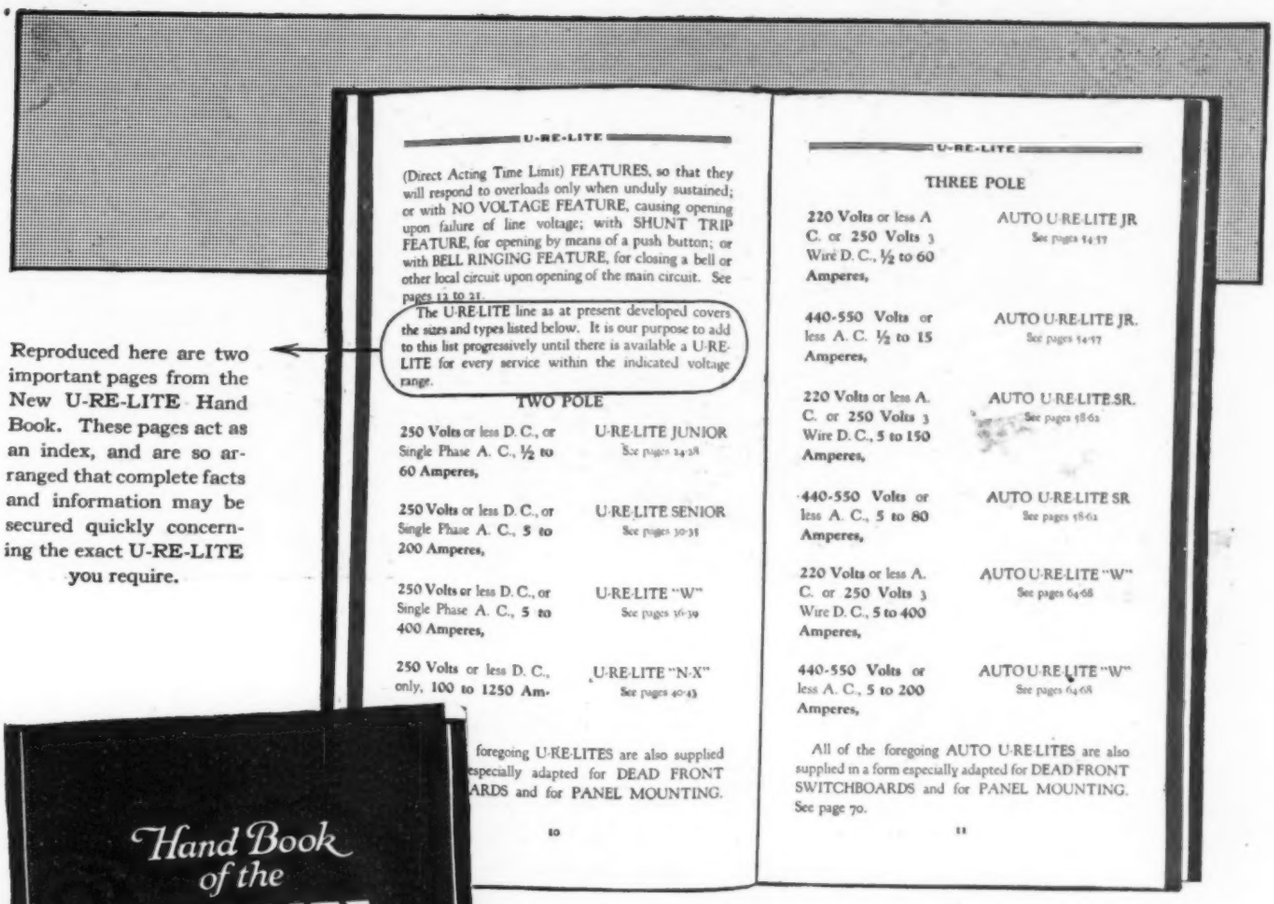
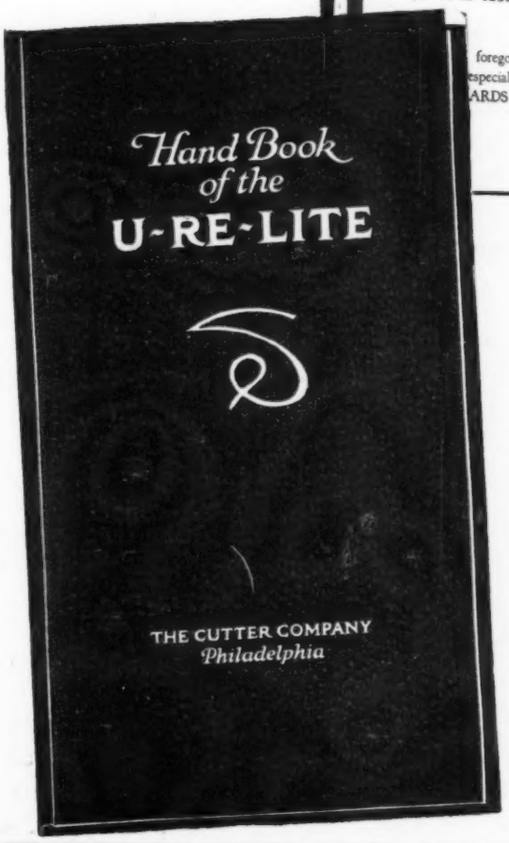
WARREN, OHIO

Transformer Manufacturers since 1890


U-RE-LITE
(Direct Acting Time Limit) FEATURES, so that they will respond to overloads only when unduly sustained; or with NO VOLTAGE FEATURE, causing opening upon failure of line voltage; with SHUNT TRIP FEATURE, for opening by means of a push button; or with BELL RINGING FEATURE, for closing a bell or other local circuit upon opening of the main circuit. See pages 12 to 21.
The U-RE-LITE line as at present developed covers the sizes and types listed below. It is our purpose to add to this list progressively until there is available a U-RE-LITE for every service within the indicated voltage range.
TWO POLE
250 Volts or less D. C., or Single Phase A. C., ½ to 60 Amperes, U-RE-LITE JUNIOR See pages 24-28
250 Volts or less D. C., or Single Phase A. C., 5 to 200 Amperes, U-RE-LITE SENIOR See pages 30-31
250 Volts or less D. C., or Single Phase A. C., 5 to 400 Amperes, U-RE-LITE "W" See pages 36-39
250 Volts or less D. C., only, 100 to 1250 Am- U-RE-LITE "N-X" See pages 40-43
foregoing U-RE-LITES are also supplied especially adapted for DEAD FRONT ARDS and for PANEL MOUNTING.
10
U-RE-LITE
THREE POLE
220 Volts or less A C. or 250 Volts 3 Wire D. C., ½ to 60 Amperes, AUTO U-RE-LITE JR See pages 14-17
440-550 Volts or less A. C. ½ to 15 Amperes, AUTO U-RE-LITE JR. See pages 14-17
220 Volts or less A. C. or 250 Volts 3 Wire D. C., 5 to 150 Amperes, AUTO U-RE-LITE SR. See pages 58-62
440-550 Volts or less A. C., 5 to 80 Amperes, AUTO U-RE-LITE SR See pages 58-62
220 Volts or less A. C. or 250 Volts 3 Wire D. C., 5 to 400 Amperes, AUTO U-RE-LITE "W" See pages 64-68
440-550 Volts or less A. C., 5 to 200 Amperes, AUTO U-RE-LITE "W" See pages 64-68
All of the foregoing AUTO U-RE-LITES are also supplied in a form especially adapted for DEAD FRONT SWITCHBOARDS and for PANEL MOUNTING. See page 70.
11

Reproduced here are two important pages from the New U-RE-LITE Hand Book. These pages act as an index, and are so arranged that complete facts and information may be secured quickly concerning the exact U-RE-LITE you require.



The U-RE-LITE is primarily an appliance for the protection from overloading electric motors and power or lighting circuits. It does this by automatically opening the circuit in the event of excessive current flow. It is, in a word, an electric safety valve. It does what fused switches are intended to do, but accomplishes this end without attendant expense. When the U-RE-LITE is opened by an overload, it does not require the insertion of renewal parts, but by a twist of the wrist may be instantly reset.

SEND FOR THIS UNUSUAL BOOK—
IT WILL BE SENT FREE

The New Hand Book of the complete U-RE-LITE line is just off the press. Contains valuable and useful data, facts and figures on the various sizes and types of the famous U-RE-LITE. Bound in boards; size 5x9¼ inches; 96 pages; illustrating the U-RE-LITE, and half-tone pictures of installations, also detailed outline drawings.

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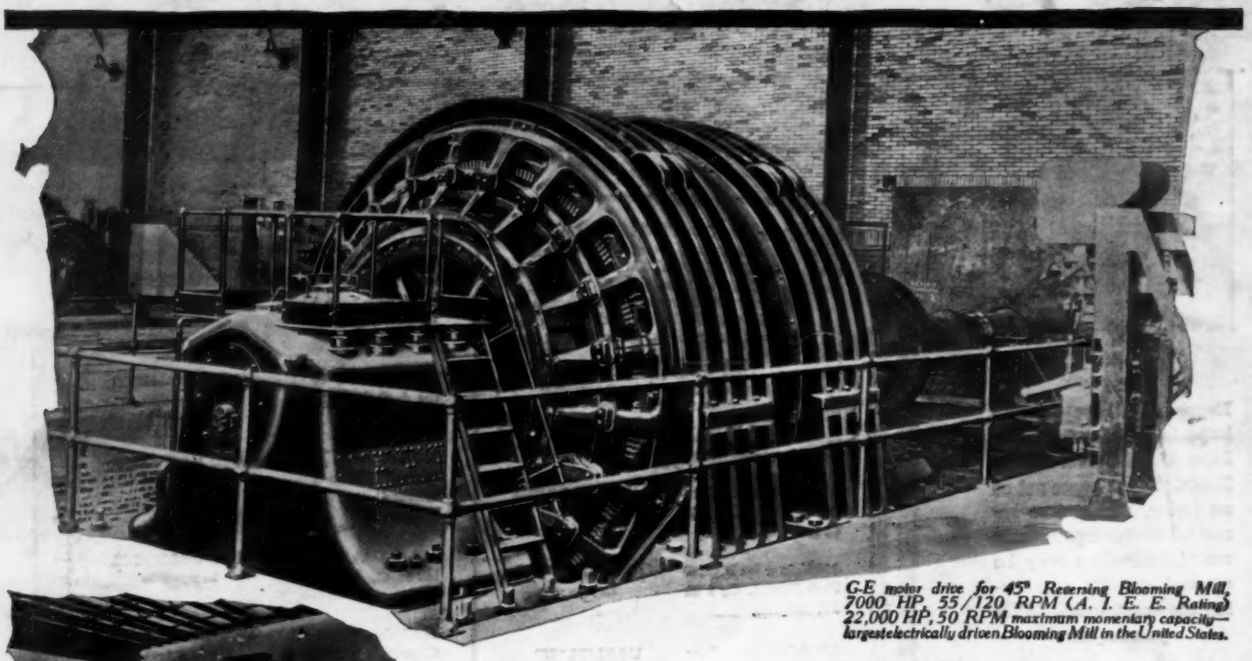
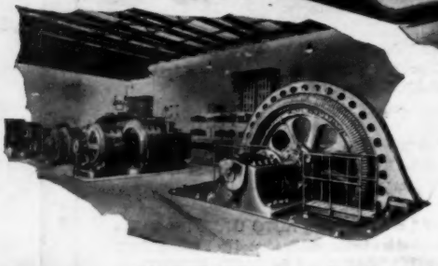
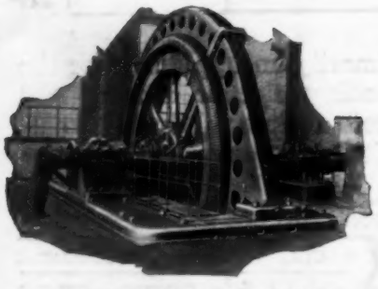


G-E motor drive for 45" Reversing Blooming Mill, 7000 HP, 55/120 RPM (A. I. E. E. Rating) 22,000 HP, 50 RPM maximum momentary capacity—largest electrically driven Blooming Mill in the United States.



G-E adjustable speed motor rated 1800/1500/1200 HP, 240/200/160RPM—driving finishing stands in 10" Hoop Mill.



G-E motor—2500 HP, 82 RPM, 6600 Volt—with breakable end thrust driving Roughing Rolls in Structural Mill.

G-E motors—true as steel

IN the leading steel mills operating main rolls with G-E motors and control devices, costs reduced through increased tonnage—lower maintenance charges—quality improved through better control, are actual performance records which show the advantages of installing G-E equipment.

The requirements of main roll drives which are being successfully met by G-E motors and control are:

Constant Speed Mills for sheet and plate mills—driven by single speed motors, usually of induction type.

Adjustable Speed Mills for strip mills and merchant mills—driven by adjustable speed induction motors with either Scherbius or rotary converter control, or by direct current motors with Ward-Leonard or motor field control.

Reversing mills—driven by direct current motors with Ward-Leonard control, or with combination of Ward-Leonard and motor field control.

The choice of the particular type of drive for any steel mill can best be determined after consideration of the factors affecting the problem by steel mill specialists of the General Electric Company. Ask our nearest office for co-operation which will be gladly given.

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